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Subfamily Cardiinae Lamarck, 1809
Genus *Acanthocardia* Gray, 1853
(type species *Cardium aculeatum* Linné, 1758)

Cardium indicum Lamarck, 1819
(Fig. 1. A-D, Fig. 2. C)

Cardium hians Brocchi, 1814: p. 508, pl. 13, fig. 6 (non Spengler, 1799).
Cardium indicum Lamarck, 1819: p. 4.
Cardium (Cardium) indicum Lamarck – Fischer-Piette, 1977: p. 112, pl. 10, fig. 4 (type).

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SALAS C., 1996. Marine Bivalves from off the Southern Iberian Peninsula collected by the Balgim and Fauna 1 expeditions. *Haliotis*, **25**: 33-100.
GRILL B. & ZUSCHIN M., 2001. Modern shallow- to deep-water bivalve death assemblages in the Red Sea - ecology and biogeography. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **168**: 75-96.
BOSS K.J., 1982. Mollusca, in Parker S.P. (ed.), *Synopsis and Classification of Living Organisms*. Vol. 1. McGraw-Hill, New York: 945-1166.
CARTER J.G., CAMPBELL D.C. & CAMPBELL M.R. 2000. Cladistic perspectives on early bivalve evolution, in Harper E.M., Taylor J.D. & Crame J.A. (eds), *The Evolutionary Biology of the Bivalvia. Geological Society, London, Special Publications*, **177**: 47-95.
VOKES H.E., 1980. *Genera of the Bivalvia: a systematic and bibliographic catalogue (revised and update)*. Paleontological Research Institution, Ithaca, Edwards Brothers Inc., 307 pp.

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Galiteuthis armata (Cephalopoda: Cranchiidae): new findings in the southern Ligurian Sea and review of its distribution in the Mediterranean Sea based on over a century of records

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Abstract

The present paper outlines the first catch of a specimen of *Galiteuthis armata* in the Tuscan coasts off the Ligurian Sea and the finding of beaks belonging to 218 specimens of the species within the gastric content of stranded teuthophagous organisms.

The specimen of *G. armata*, perfectly preserved, was caught by bottom trawl net during a scientific deep-sea survey carried out in the years 2007-2008 off the Tuscan coasts. This finding, not only confirms the presence of this species in the Southern Ligurian Sea, but also provides morphometric data, which are sparsely available in the case of this species. A linear regression was calculated, linking mantle length to lower beak rostral length.

The teuthophagous predators, in the stomachs of which the remains of *G. armata* were found, are the odontocete cetaceans *Grampus griseus*, *Stenella coeruleoalba* and *Physeter catodon*, and the teleost *Lampris guttatus*, all of them found stranded in the area between 2008 and 2016.

The large amount of specimens found (whether complete or in portions), as well as several other findings reported for the Northern Ligurian Sea, suggest that the presence of *G. armata*, usually considered as a rarity in the Mediterranean, is instead more common than assumed, at least in the Ligurian Sea.

Besides, from a review of all existing reports (both direct and indirect) concerning findings of this species in the Mediterranean a greatest presence of *G. armata* emerges in the western part of the Mediterranean Sea compared to the eastern part.

Key words

Cephalopoda, *Galiteuthis armata*, Cranchiidae, Mediterranean Sea, new record.

Riassunto

Nel presente lavoro si segnalano, nell'area del Mar Ligure prospiciente la costa toscana, la prima cattura di un esemplare di *Galiteuthis armata* ed il rinvenimento dei becchi di 218 esemplari della stessa specie nei contenuti gastrici di organismi teutofagi spiaggiati.

Il campionamento dell'esemplare di *G. armata*, in ottimo stato di conservazione, è avvenuto durante una campagna scientifica di pesca abissale condotta negli anni 2007-2008 al largo delle coste toscane; questo ritrovamento permette di confermare la presenza della specie nel Mar Ligure meridionale e, inoltre, di disporre di alcuni dati morfometrici che per questa specie sono scarsamente disponibili. È stata anche calcolata l'equazione di una retta di regressione correlante la lunghezza del mantello alla lunghezza rostrale del becco inferiore.

I predatori teutofagi nel cui stomaco sono stati rinvenuti i resti di *G. armata* sono i cetacei odontoceti *Grampus griseus*, *Stenella coeruleoalba* e *Physeter catodon*, e il teleosteo *Lampris guttatus*, tutti rinvenuti spiaggiati nella stessa area tra il 2008 e il 2016.

Il numero non trascurabile di esemplari individuati, insieme a numerose altre segnalazioni relative al Mar Ligure settentrionale, fa ritenere che *G. armata*, generalmente ritenuta rara nel Mediterraneo, in quest'area sia in realtà più frequente di quanto ipotizzato.

Nel presente lavoro, inoltre, è stata fatta una revisione di tutte le segnalazioni dirette ed indirette relative a questa specie nel Mediterraneo; è risultato che la presenza di *G. armata* è decisamente più consistente nella parte occidentale del Mediterraneo rispetto a quella orientale.

Parole chiave

Cephalopoda, *Galiteuthis armata*, Cranchiidae, Mar Mediterraneo, nuovi ritrovamenti.

Introduction

Galiteuthis armata Joubin, 1898 (Cephalopoda: Cranchiidae) was described on a specimen found in the western Mediterranean Sea, off Nice. Members of the Cranchiidae show a wide morphological diversity, including their size. Depending on the species, size may range from small (10 cm dorsal mantle length, DML) to very large (ca. 200 cm DML) (Jereb & Roper, 2010). This family is subdivided in two subfamilies, Cranchiinae and

Taoniinae, both of them represented in the Mediterranean (Bello, 2004; 2008). *Galiteuthis armata*, the subject of this paper, belongs to the latter subfamily.

Galiteuthis armata can be found distributed along the water column over a large bathymetric range since it performs a gradual ontogenetic descent (Roper & Young, 1975; Villanueva, 1992). Its paralarvae are common in the upper water layers, where they usually stay until they reach the size of 50 - 100 mm DML (Voss et al., 1992). Larger specimens' concentration peaks can be

found at depths below 1300 m (Jereb & Roper, 2010). The largest observed individual measured 610 mm DML (Jereb & Roper, 2010).

Galiteuthis armata is a Mediterranean resident and the only cranchiid species established in the area. The occurrence of other species of the same family is to be considered occasional and limited to the western basin, mainly close to the Straits of Gibraltar (Jereb & Roper, 2010). The species is also present in the Atlantic Ocean, from 62°N to 25°S, thus its distribution comprises tropical, subtropical and temperate waters (Jereb & Roper, 2010).

In the Mediterranean, only sporadic specimens of *G. armata* have been collected, with individuals at different stages of development. In addition, several remains (mainly beaks) have been retrieved within-gastric contents of teuthophagous predators. As Clarke (1977) said “*Samples from nets and predators are complementary in content and both are needed to obtain anything approaching a realistic picture of the cephalopods of a region*”.

The aim of this paper is to add a further proof of the presence of this cranchiide in the southern Ligurian Sea. An overview of all records of *G. armata* is provided, in order to review its distribution in the Mediterranean Sea and to update the review made by Clarke (1966) half a century ago. Furthermore, a correlation between dorsal mantle length and lower beak length was derived, which may be used to estimate body size from beak remains found in the stomach contents of teuthophagous predators.

Materials and methods

A specimen of *Galiteuthis armata* was caught during a deep sea bottom trawl survey within the framework of BioMarT (ARPAT, 2009), a project carried out by Arpat, an agency of Tuscany Region, aiming at compiling a comprehensive list of the marine flora and fauna of the waters off the Tuscan coasts. The survey was carried out using a bottom trawl net in the area north of Capo Corso and west of the Santa Lucia Bank, at depths ranging from 609 to 1480 m. The trawls were carried out during the daytime, so as to ensure a large presence on the sea-bottom of species that accomplish vertical migrations.

The specimen of *G. armata*, perfectly preserved, was caught on 2nd May 2008, at 43°36'34" N and 09°18'40" E at a depth between 1149 m and 1191 m. After being examined in the laboratory, the specimen was preserved in ethyl alcohol (75 %) and is now kept in the ARPAT teuthologic collection. Total weight (g) and the main morphometric data (mm) were measured. The buccal mass was extracted and the beaks examined; the lower beak's rostral length (LRL) was measured.

Considering the absence, in the scientific literature concerning *G. armata*, of a ratio between LRL and dorsal mantle length (DML), calculations of parameters for a linear regression were done, using the five available

couples of data, namely one measured directly on the specimen reported in this paper, and the others derived from measures found in the bibliography (Clarke, 1986; Lefkaditou & Maiorano, 2001; Garibaldi & Podestà, 2014).

Some beaks of *G. armata* were found in the gastric contents of two specimens of *Grampus griseus* (Cetacea: Delphinidae) stranded in Viareggio (Lucca, Tuscany) on 15.04.2012, and of two specimens of *Stenella coeruleoalba* (Cetacea: Delphinidae), that were found stranded one in Viareggio on 27.03.2008 and the other one in Bibbona (LI) on 11.03.2013. The results of the analysis of the gastric contents of these specimens have already been reported by Berti et al. (2014) and by Pedà et al. (2015), including measurements of rostrum length of the lower beaks (LRL). Using the calculated ratio between LRL and DML, it was thus possible to estimate the sizes of the predated specimens. Moreover, making use of the equation linking LRL to weight, reported in Romeo et al. (2012), estimates of the specimen's weights were also obtained.

Furthermore, a number of *G. armata* beaks were identified in the stomach content of two specimens of opah, *Lampris guttatus* (Osteichthyes: Lampridae), one of them found stranded in Vada (Livorno) on 08.08.2008 and reported by Ligas et al. (2009), while the other was caught by a fisherman in Marina di Pisa on 30.12.2016. Finally, more beaks of *G. armata* were found in the stomach of two specimens of *Physeter catodon* (Cetacea: Physeteridae) stranded in Castiglioncello (Livorno) on 18.11.2014 and in Calambrone (Livorno) on 01.08.2016. The identification was made by examination of lower beaks, following the description made by Clarke (1986) and confirmed after a cross-checking with the ARPAT collection of cephalopod beaks.

In order to define the distribution of *G. armata* in the Mediterranean basin, an extensive bibliographic research was carried out, starting from the first finding which prompted Joubin to first describe the species in 1898. The information has been collected from publications or personal communications. The reports have been classified per geographical area and, when data were available, per life cycle stage. Finally, still focusing on the Mediterranean, information was collected concerning the presence of beaks of this species which were found in the gastric contents of teuthophagous predators. In the analyses, the Mediterranean Sea was subdivided into Western Mediterranean, Central M., Eastern M. and Adriatic Sea. The central Mediterranean, often not covered in the oceanographic works, has been added during the analysis of species distribution data just to highlight some obtained results. The present work with “Central Mediterranean” refers to the area between the Sicilian-Tunisian threshold to the west and the Aegean and Libyan seas to the east.

Results

The map in Fig. 1 shows the site where the complete

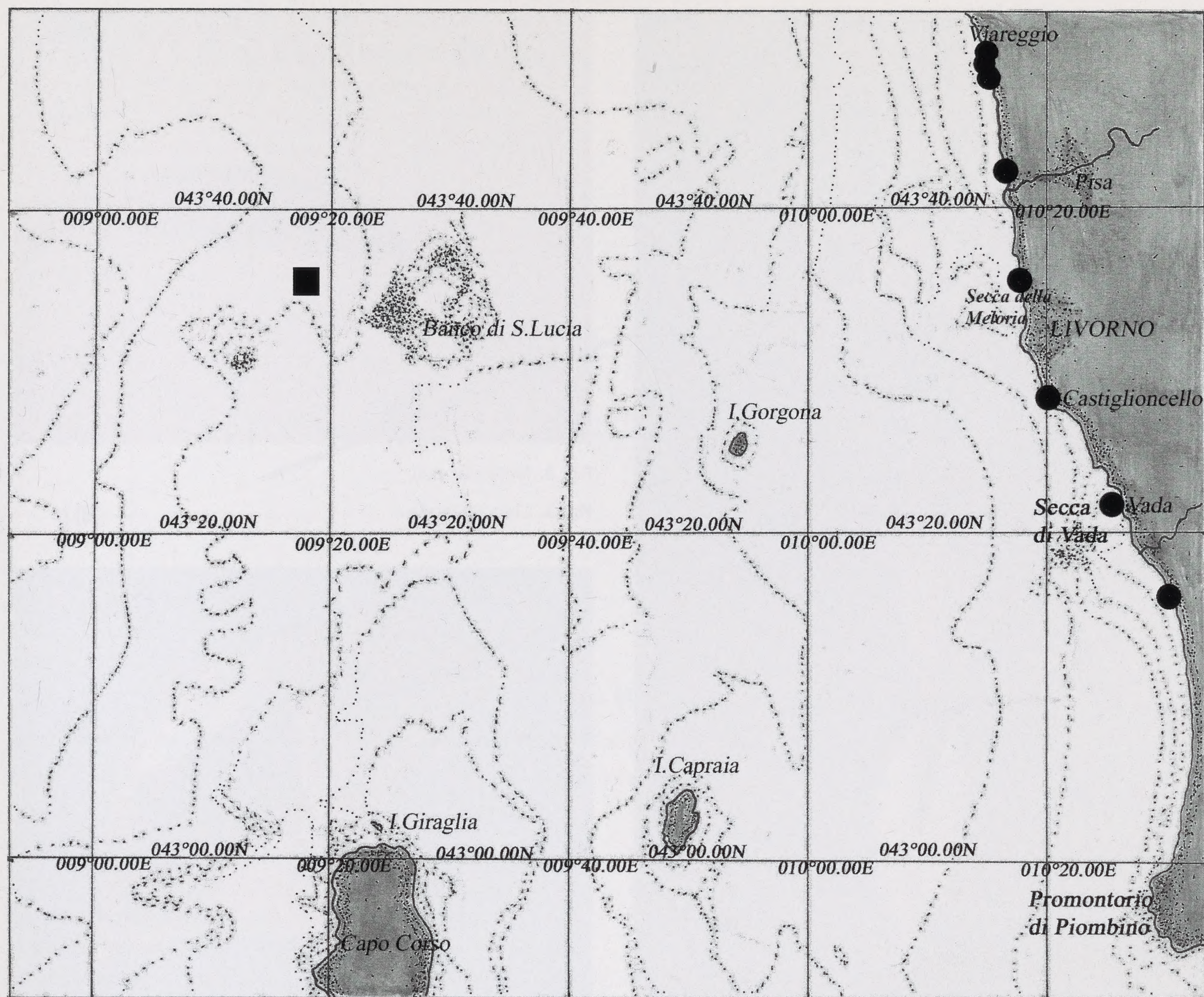


Fig. 1 Findings of *Galiteuthis armata* in Tuscan waters. ■ Point where the specimen was caught; ● Coastline spots where teuthophagous predators got stranded, whose stomachs contained beaks from the species.

Fig. 1. Ritrovamenti di *Galiteuthis armata* in acque toscane. ■ Punto di ritrovamento dell'esemplare catturato; ● punti della costa dove si sono spiaggiati i predatori teutofagi nei cui stomaci erano presenti i becchi della specie.

specimen was caught and the eight sites along the coast where the stranded teuthophagous predators containing beaks of *G. armata* into their stomachs were found. The complete specimen, found perfectly preserved (Fig. 2), was identified as *G. armata* in accordance with the description contained in Jereb & Roper (2010) and in Young (2011). Indeed, the presence of the external morphological traits that are typical of this species, were observed, namely: lanceolate fins, stretched out along the back part of the mantle; presence of a thin and elongated back part of the mantle stretching styliformly past the back rim of the fins; prominent globose eyes; ocular photophores with a slightly curved bar (Fig. 3); arms with regular suckers (no hooks); tentacles bearing two series of suckers which become four series close to the carpal pad; tentacular club bearing little suckers and hooks (Fig. 4); siphon/mantle closing apparatus bearing little tubercles. The main morphological measurements of the specimen, including the lower beak rostral length (Fig. 5), are given in Table 1. It was defined as an immature specimen, of undetermined sex. The cetacean's gastric contents provided 15 lower beaks

of *G. armata*, 6 of these in the stomachs of two striped dolphins, and 9 in the stomachs of two Risso's dolphins. The chart in Fig. 6 shows the linear regression line obtained from the five pairs of data available for LRL and DML. Measurements of the beaks, evaluations of mantle lengths, and relative weights are given in Tab. 2. Furthermore, 182 beaks of this species were found in the stomach of a specimen of *L. guttatus* and 21 beaks were found in the stomach of two specimens of *P. cato-don*; more details about this will be the object of a coming publication (Capua et al., in preparation). Findings of *G. armata* specimens in the Mediterranean Sea are given in Tab. 3 and Fig. 7. The table shows reports ordered from western-basin-to-eastern-basin. It must be pointed out that in some cases, at the beginning of the past century, the species was reported with different denominations, *Galiteuthis* (*Taonidium*) *suhmii* in the case of Chun (1910), which was considered a synonym for *G. armata* by Naef (1923), and *Taonidium* *pfef-feri* in the case of Degner (1925), successively considered a synonym by Salman (2009) and by Jereb and Roper (2010). In the figure, an arbitrary measure of 50 mm



Fig. 2. *Galiteuthis armata*, dorsal view of the specimen caught off the coast of Livorno.

Fig. 2. *Galiteuthis armata*, vista dorsale dell'esemplare catturato al largo di Livorno.

Weight (g)	13
Total Length (mm)	340
Dorsal Mantle Length (mm)	220
Ventral Mantle Length (mm)	216
Mantle Width (mm)	24
Head Length (mm)	20
Head Width (mm)	23
Fin Length (mm)	83
Fin Width (mm)	18
Lower Beak Rostral Length (mm)	2.3
Tentacle Length (mm)	91
Arms Length (I-II-III-IV) (mm)	30-39-46-51

Table 1. Morphometric measures of the *Galiteuthis armata* specimen seized off the coast of Livorno.

Tab. 1. Misure morfometriche dell'esemplare di *Galiteuthis armata* catturato al largo di Livorno.



Fig. 3. Tentacular club.

Fig. 3. Clava tentacolare.

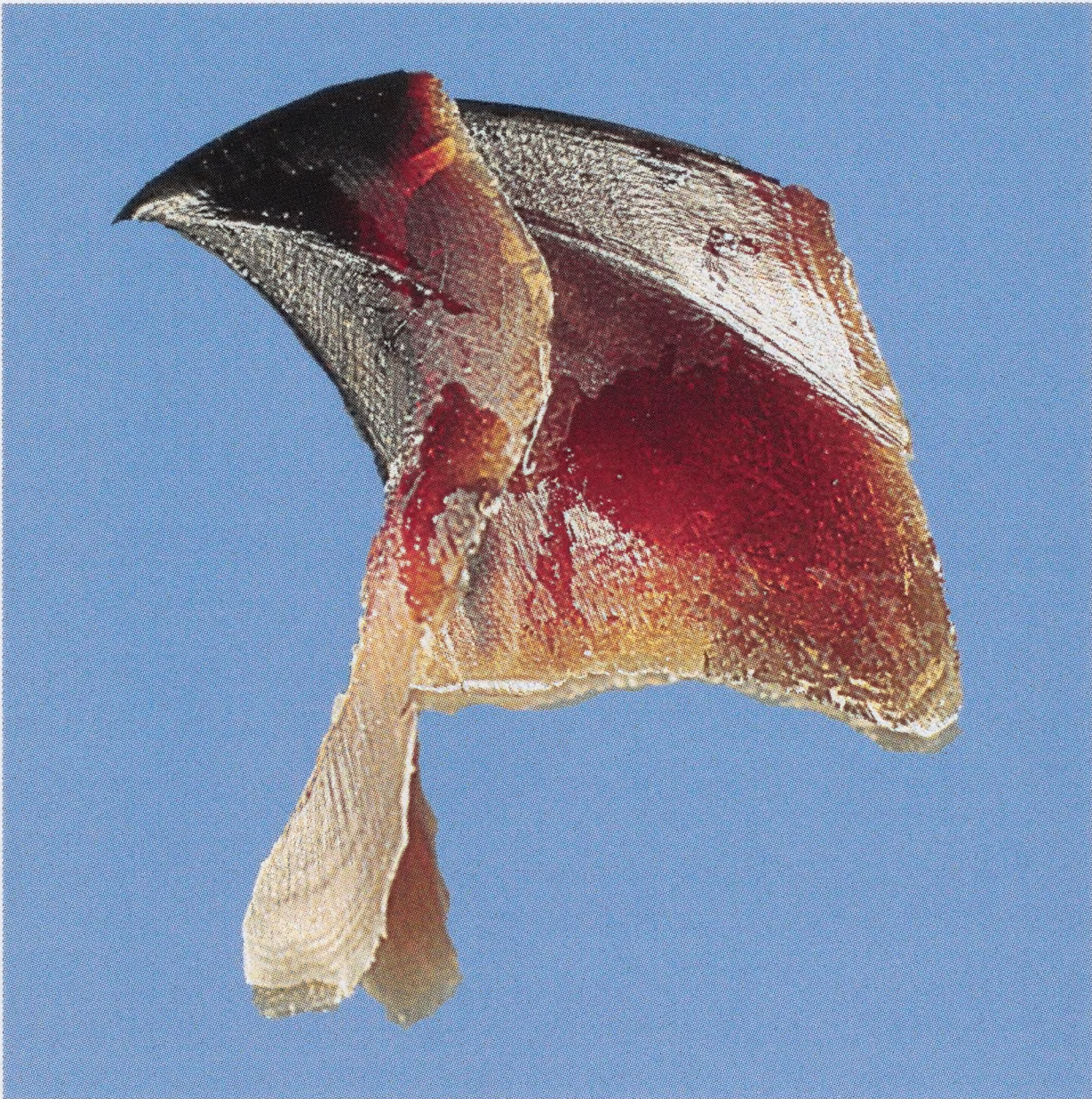


Fig. 4: Lower beak.

Fig. 4: Becco inferiore.

DML has been assumed as a threshold to separate early juvenile stages and palalarvae from sub-adult and adult specimens. In total, 31 specimens with DML > 50 mm, and 43 specimens with DML < 50 mm are reported. As regards the bigger specimens, 29 proceed from the western Mediterranean, and 2 from the Ionian Sea, in the central Mediterranean. Regarding the smaller specimens, 32 proceed from the western Mediterranean, 8 from the central Mediterranean, and 3 from the eastern Mediterranean.

In **Tab. 4** and in **Fig. 8** indirect reports concerning *G. armata* in the Mediterranean Sea are provided, which were obtained through the identification of beaks contained in the stomachs of teuthophagous predators; in this case, too, the order observed is, approximately, eastwards. The figure shows sites where the predators were caught or found stranded. In total, 497 findings of beaks were recorded, of these, 485 can be ascribed to the western Mediterranean, 3 to the central Mediterranean, and 9 to the Adriatic Sea.

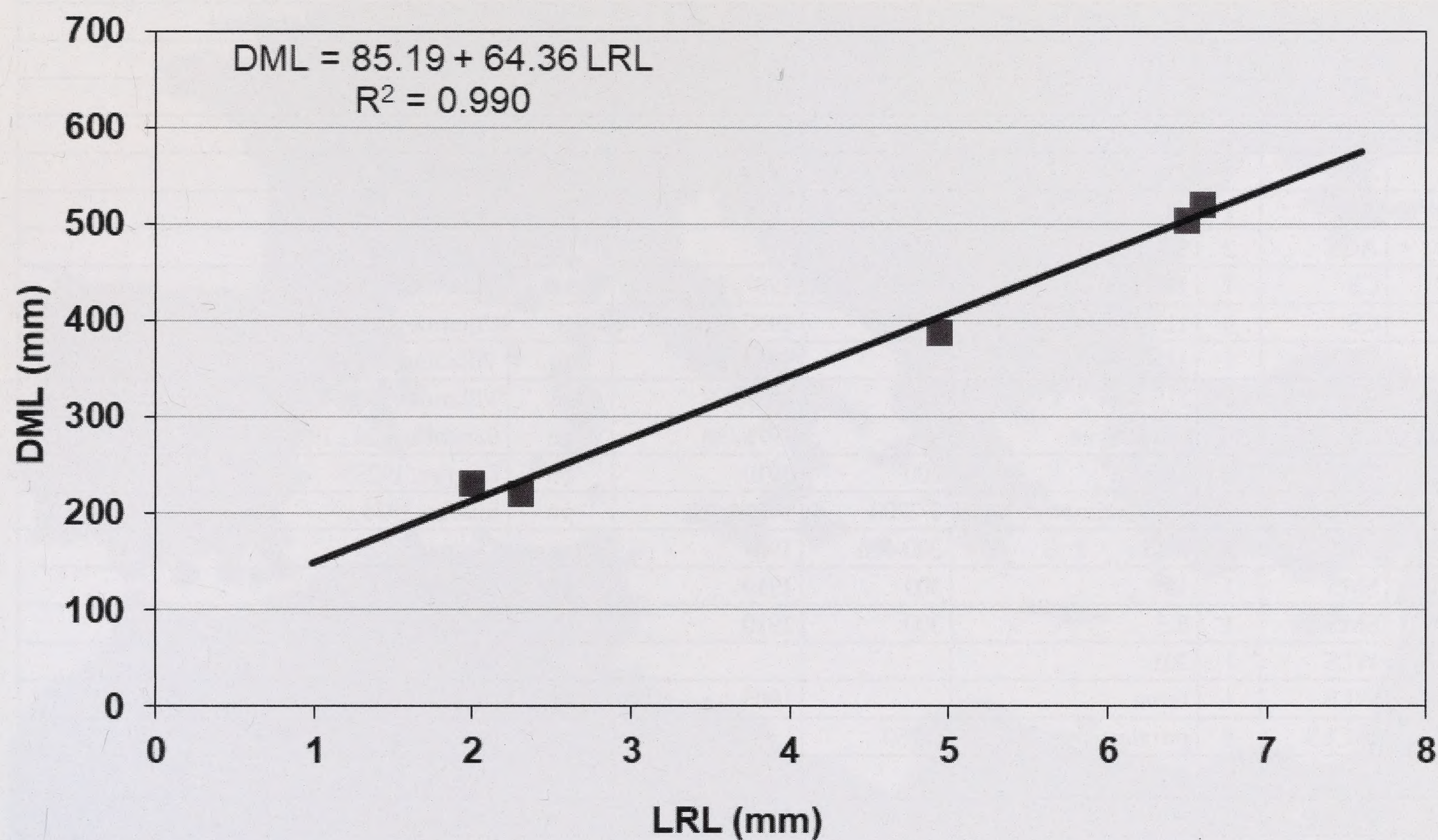


Fig. 5. Dorsal Mantle Length (DML) and Lower beak Rostral Length (LRL) correlation in *Galiteuthis armata*.

Fig. 5. Relazione tra Lunghezza Dorsale del Mantello (LDM) e lunghezza del rostro del becco inferiore (LRI) in *Galiteuthis armata*.

Discussion

The presence of *G. armata* in the Mediterranean check lists has already been confirmed for several decades (Bello, 1986; Mangold & Boletzky, 1987; Bello, 2004; 2008; Capua, 2013; Crocetta et al., 2014), also in Italy’s seas (Capua, 2004; Bello, 2004; 2008). The finding of a juvenile specimen of *G. armata* caught utilizing a trawling net in the Southern Ligurian Sea is the latest of a series of reports concerning specimens of this species caught at different occasions in the north-western part of the Ligurian Sea, by means of IK-MT nets (Orsi Relini et al., 1994; Orsi Relini & Garibal-

di, 2005). These were primarily larvae or juvenile specimens, but also some bigger specimens, up to 45.5 cm DML, were caught (Fulvio Garibaldi, personal communication). Furthermore, within the same area, several beaks of this species were found in the gastric contents of teuthophagous predators such as the odontocete cetaceans *G. griseus*, *S. coeruleoalba* and *P. catodon*, and the teleost *L. guttatus*. These findings represent additional information to other reports of findings concerning the northern part of the Ligurian Sea, where remains of *G. armata* were reported in the stomachs of swordfish (Orsi Relini et al., 1995) and Cuvier’s beaked whale, *Ziphius cavirostris* (Orsi Relini & Garibaldi, 2005). The non-neg-

<i>Grampus griseus</i>			<i>Stenella coeruleoalba</i>		
LRL (mm)	DML* (mm)	W** (g)	LRL (mm)	DML* (mm)	W** (g)
4.5	375	57.9	5.7	452	98.1
3.6	317	35.2	3.6	317	35.2
3.3	298	29.0	3.5	310	33.0
3.0	278	23.4	3.5	310	33.0
2.6	253	17.0	3.2	291	27.0
2.6	253	17.0	3.1	285	25.2
2.3	233	12.9			
2.3	233	12.9			
1.5	182	5.0			
* DML = 85.19 + 64.36 LRL (Present work)					
**Ln(W) = 0.70 + 2.23*Ln(LRL) (Romeo et al., 2012)					

Table 2. Length of *Galiteuthis armata* lower beaks (LRL), from the remains found in the stomachs of cetaceans stranded along the Tuscan coastline and computation of corresponding lengths of the mantle (DML) and of single weights (W). At the bottom, the equations used to estimate DML and W.

Tab. 2. Lunghezza del rostro del becco inferiore (LRL) dei reperti di *Galiteuthis armata* trovati negli stomaci dei cetacei spiaggiati sulla costa toscana e stima delle corrispondenti lunghezze del mantello (DML) e dei pesi individuali (W). In basso, le equazioni utilizzate per stimare DML e W.

	Sea area	n°	DML (mm)	Depth (m)	Year	Met	Reference
1	AS	1	267	725	1970/72	tn	Mangold-Wirtz, 1973
2	AS	1		670	1970/72	tn	Mangold-Wirtz, 1973
3	AS	1	9.5	2600	1909	pn	Degner, 1925
4	AS	1	73	2000	1910	pn	Degner, 1925
5	AS	1	73	1600	1909	pn	Degner, 1925
6	ACS	2	90-182	0-900		pn	Roper, 1972
7	CS	1	115-488	1007	1987/89	tn	Villanueva, 1992
8	CS	5	115-488	1575	1987/89	tn	Villanueva, 1992
9	CS	1	115-488	1707	1987/89	tn	Villanueva, 1992
10	CS	1	115-488	2208	1987/89	tn	Villanueva, 1992
11	CS	>1	paralarvae		1976/96	pn	Sanchez et al., 1998
12	SMS	2	14.5-18	300	1910	pn	Degner, 1925
13	SMS	1	192 (estimate)	0-2700	1911	pn	Joubin, 1924
14	SMS	3	5-16	300-600	1909	pn	Degner, 1925
15	SMS	1	13	300	1910	pn	Degner, 1925
16	SMS	1	8.5	300	1910	pn	Degner, 1925
17	WLS	1	201				Joubin, 1898
18	WLS	1	larva		1905	pn	Joubin, 1920
19	WCLS	8	paralarvae	0-750		pn	Orsi Relini et al., 1994
20	WCLS	3	5-7	300	1909	pn	Degner, 1925
21	WCLS	1	31	0-800	2002/03	pn	Orsi Relini & Garibaldi, 2005
22	WCLS	1	23	0-800	2002/03	pn	Orsi Relini & Garibaldi, 2005
23	WCLS	5	106-130-154 230-455	0-800	1988-2002	pn	Garibaldi, pers. com.
24	CoS	6	10-13-25 31-34-43	0-1000		pn	Roper, 72
25	SLS	1	220	1170	2008	tn	presente lavoro
26	NTS	1		480-620	1966-69	tn	Lumare, 1970
27	AG	1		480-620	1966-69	tn	Lumare, 1970
28	MS	2	46-141 (estimate)		1910		Chun, 1910
29	MS	1	262 (estimate)				Naef, 1923
30	MS	1	134		1916	nsn	Mortara, 1917
31	MS	1	70		1916	st	Mortara, 1917
32	MS	1	98 (estimate)		1960	nsn	Torchio, 1965
33	MS	1	14		1974	st	Berdar & Cavallaro, 1975
34	WIS	1	6	1000	1910	pn	Degner, 1925
35	WIS	1		1123	2006/7	tn	Maiorano et al., 2010
36	IS	1	12	600		pn	Roper, 1972
37	IS	2	3.6-8	60-100	1994	pn	Balducci & Piccinetti, 2009
38	IS	1	3.6-8	60-100	1994	pn	Balducci & Piccinetti, 2009
39	IS	2	3.6-8	60-100	1994	pn	Balducci & Piccinetti, 2009
40	IS	1	3.6-8	60-100	1994	pn	Balducci & Piccinetti, 2009
41	NEIS	1	231	1015	1999	tn	Lefkaditou & Maiorano, 2001
42	LS	1	10	300	1910	pn	Degner, 1925
43	LS	2	8-9	300	1910	pn	Degner, 1925

Table 3. List of capture reports of *Galiteuthis armata* in the Mediterranean. The sea areas where the finding took place, the number of specimen, the dimensions of the mantle (DML), the depth of the finding, the year and the collecting method (Met) are reported (when available).
Sea area legend: AS = Alboran Sea; CS = Catalan Sea; ACS = Alboran/Catalan Sea; SMS = Southern Medit. Sea; WLS = Western Ligurian Sea; WCLS = West-Central Ligurian Sea; CoS = Corsica Sea; SLS = Southern Ligurian Sea; NTS = Northern Tyrrhenian Sea; AG = Asinara Gulf; MS = Messina Strait; WIS= Western Ionian Sea; IS = Ionian Sea; NEIS = North-Eastern Ionian Sea; LS = Levantine Sea.
Collecting method legend: tn = trawl net; pn = plankton net; nsn = not specified net; st = stranding.

Tab. 3. Elenco delle segnalazioni di catture di *Galiteuthis armata* nel Mediterraneo. Sono riportati (quando disponibili) il bacino dove è avvenuto il ritrovamento, il numero di esemplari, le dimensioni del mantello (DML), la profondità di ritrovamento, l'anno e il metodo di raccolta (Met). Legenda delle aree marine: AS = Mar di Alboran; CS = Mar Catalano; ACS = Mar di Alboran/Catalano; SMS = Mediterraneo meridionale; WLS = Mar Ligure occidentale; WCLS = Mar Ligure centro-occidentale; CoS = Mare di Corsica; SLS = Mar Ligure meridionale; NTS = Mar Tirreno settentrionale; AG = Golfo dell'Asinara; MS = Stretto di Messina; WIS = Mar Ionio occidentale; IS = Mar Ionio; NEIS = Mar Ionio nord-orientale; LS = Mar Levantino. Legenda del metodo di raccolta: tn = rete da traino; pn = rete per plancton; nsn = rete non specificata; st = spiaggiamento.

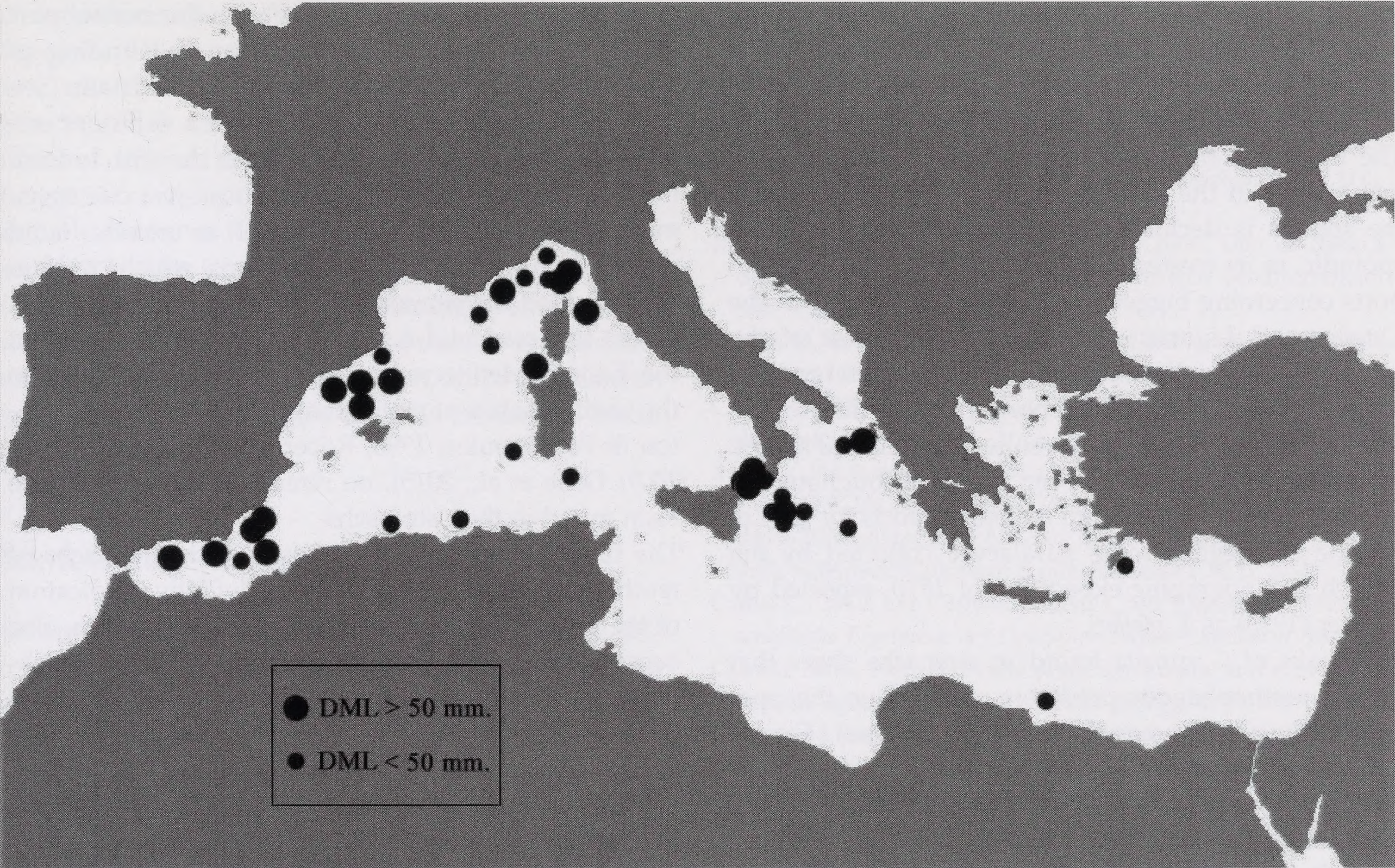


Fig. 6: *Galiteuthis armata* specimens in reports relative to the Mediterranean.

Fig. 6: Catture di esemplari di *Galiteuthis armata* segnalate nel Mediterraneo.

	Sea area	Area	n°	Predator	n° Predators	Reference
1	ACS	Spanish coast	71	<i>Z. cavirostris</i>	2	Blanco & Raga, 2000
2	CS	Spanish coast	5	<i>G. griseus</i>	15	Blanco et al, 2006
3	WLS	Savona	28	<i>Z. cavirostris</i>	1	Orsi Relini & Garibaldi, 2005
4	NLS	Genova	29	<i>Z. cavirostris</i>	1	Orsi Relini & Garibaldi, 2005
5	NLS	Chiavari-Sanremo	115	<i>X. gladius</i>	126	Orsi Relini et al., 1995
6	NLS	Chiavari-Sanremo	1	<i>P. glauca</i>	11	Orsi Relini et al., 1994
7	SELS	Forte dei Marmi	2	<i>P. catodon</i>	1	Garibaldi & Podestà, 2014
8	SELS	Viareggio	9	<i>G. griseus</i>	2	Pedà et al., 2015
9	SELS	Marina di Pisa	1	<i>L. guttatus</i>	1	Capua, pers. oss.
10	SELS	Livorno	20	<i>P. catodon</i>	1	Capua, pers. oss.
11	SELS	Castiglioncello	1	<i>P. catodon</i>	1	Capua, pers. oss.
12	SELS	Vada	181	<i>L. guttatus</i>	1	Capua, pers. oss.
13	SELS	Tuscan coast	5	<i>S. coeruleoalba</i>	19	Pedà et al., 2015
14	STSMS	Sicilian coast	16	<i>X. gladius</i>	124	Romeo et al., 2012
15	STSMS	Sicilian coast	1	<i>T. thynnus</i>	123	Musolino, 2011
16	IS	Taranto gulf	3	<i>X. gladius</i>	38	Bello, 1991
17	EAS	Montenegro	9	<i>Z. cavirostris</i>	1	Kovačić et al., 2010

Table 4. List of finding reports of remains of *Galiteuthis armata* in teuthophagous predators’ gastric contents in the Mediterranean. The sea and the geographic area of seizure, the spots where the predators were stranded, the number of identified specimens, the species and number of analyzed predators, are reported. Sea area legend: ACS = Alboran/Catalan Sea; CS = Catalan Sea; WLS = Western Ligurian Sea; NLS = Northern Ligurian Sea; SELS = South-eastern Ligurian Sea; STSMS = Southern Tyrrhenian Sea/ Messina Strait; IS = Ionian Sea; EAS = Eastern Adriatic Sea.

Tab. 4. Elenco delle segnalazioni dei ritrovamenti di resti di *Galiteuthis armata* nei contenuti gastrici di predatori teutofagi nel Mediterraneo. Sono riportati il bacino e l’area dove è avvenuta la cattura o lo spiaggiamento dei predatori, il numero di esemplari identificati, la specie ed il numero di predatori analizzati. Legenda delle aree marine: ACS = Mar di Alboran/Catalano; CS = Mare Catalano; WLS = Mar Ligure Occidentale; NLS = Mar Ligure settentrionale; SELS = Mar Ligure Sud Orientale; STSMS = Mar Tirreno Meridionale/ Stretto di Messina; IS = Mar Ionio; EAS = Mare Adriatico Orientale.

ligible numbers of the identified specimens, obtained through direct and indirect sampling in different areas of the Ligurian Sea, must induce to a reconsideration of the frequency of presence of this species, usually con-

sidered as a rarity in the Mediterranean, where it must in fact be more frequent than assumed: A statement by Clarke (1966) on this point is worth remembering: “Many species of squid, which are important in the diet of

predators, are rarely, if ever, caught by man-made collecting devices". Similar considerations on the same topic as well as on the different predatory selectivity of the different species can also be found in Bello (1997).

The table and map showing the reported findings of this species in the Mediterranean clearly indicate that the species is decidedly more frequent, even though sporadic, in its western part. The highest number of reports concerning bigger specimens concentrated in the Catalan and Ligurian Seas while in the east of the Messina Straits only two specimens have been reported in the Ionian Sea, and no reports concern the Aegean and Levantine Seas. Early juvenile or paralarval stages, on the other hand, have been found throughout the Mediterranean, even though the only reports for the Levantine Sea regard some paralarvae collected by the Danish oceanographic expedition of 1910, reported by Degner (1925) as *T. pfefferi*.

The beaks of *G. armata* found in stomachs show that several teuthophagous predators can feed on this species. *Ziphius cavirostris* (Cetacea: Ziphiidae), *G. griseus*, *S. coeruleoalba*, *Physeter catodon* (Cetacea: Physeteridae), *L. guttatus*, *Xiphias gladius* (Osteichthyes: Xiphiidae), *Thunnus thynnus* (Osteichthyes: Scombridae), *Prionace glauca* (Chondrichthyes: Carcharhinidae) are the predators which are confirmed to have fed on this species. The table and map displaying sites where beaks of *G. armata* have been found in predators' stomachs show how this occurrence was predominantly reported in the Western Mediterra-

nean and, only much more rarely, in the central part of the Mediterranean. In particular, the finding of beaks of *G. armata* in the Southern Adriatic Sea (Kovačić et al., 2010) is not considered a sufficient evidence of the presence of this species in the area. Indeed, it only concerns the stomach content of just one specimen of *Z. cavirostris*, a powerful swimmer, found stranded on the coasts of Montenegro, which could in fact have fed further south, possibly in the Ionian Sea, where this cranchiid has been previously reported. In the Eastern Mediterranean, despite many studies into the feeding habits of teuthophagous predators (Lefkaditou & Pouloupoulos, 1998; Roberts, 2003; Ozturk et al., 2007; Dede et al., 2015), no remains of *G. armata* have been found in their stomachs.

The finding of cephalopoda beaks in the stomachs of teuthophagous predators is not a definitive indication of the presence of any species within a given area, also because they are often predators which can move quickly from one area to the other. However, also on the basis of the numbers of reported cases, this information contributes to the definition of a wider area of distribution. It is considered not fortuitous the convergence of the indications arising from the two different approaches, one direct, the other indirect, which have been employed in order to affirm that the distribution of *G. armata* in the Mediterranean is certainly located in its western part. The reports of its presence in the Levantine Sea (Degner, 1925; Rees, 1955; Ruby & Knudsen, 1972; Salman et al., 2002; Salman, 2009; Salman, 2012)

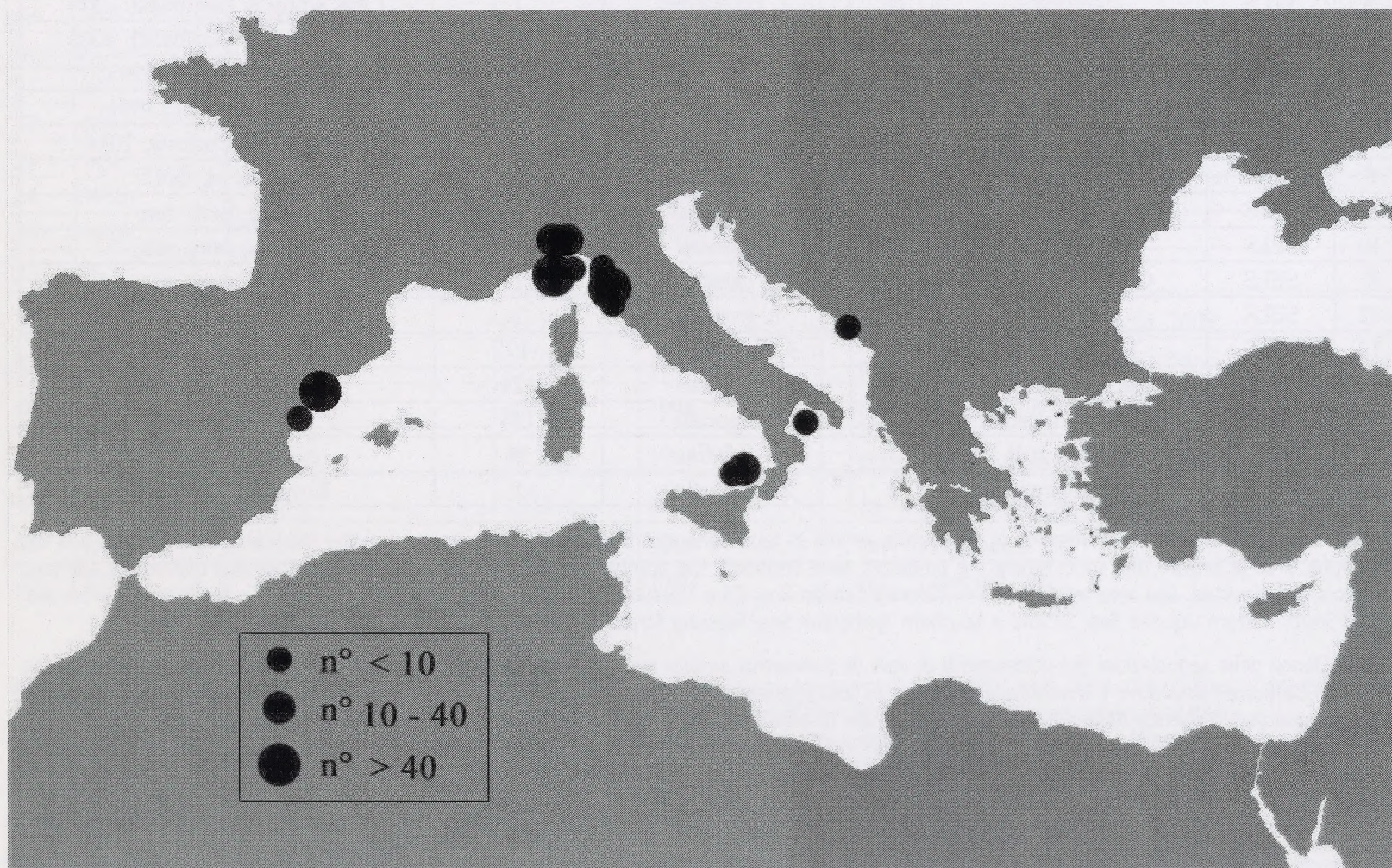


Fig. 7. Beaks of *Galiteuthis armata* in teuthophagous predators' stomachs in the Mediterranean. The numbering refers to the amount of specimens of this species for each report, regardless of the number of predators which have been looked into.

Fig. 7. Becchi di *Galiteuthis armata* negli stomaci di predatori teutofagi nel Mediterraneo. La numerazione si riferisce alla quantità di esemplari della specie per ciascuna segnalazione, indipendentemente dal numero di predatori indagati.

all derive from the finding of larval forms identified by Degner in 1910, to which all Authors refer to.

As Clarke (1977) suggested, the bulk of information obtained through direct findings of specimens caught by means of different methods, and through the analysis of the gastric contents of teuthophagous organisms, is essential in order to have a realistic outline of the presence of a species in a given region.

Reports of diverse typology concerning *G. armata* in the Mediterranean Sea show that its presence is decidedly more substantial in the western part, and that it considerably decreases as one goes towards the Eastern Mediterranean.

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Report from Bangka Pulau (Indonesia): Cerithiopsidae

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Abstract

In this paper are reported 46 species of Cerithiopsidae from Bangka Pulau, island at North Sulawesi (Indonesia), 38 are known and 8 new for the science (*Horologica forlii* n. sp., *Joculator bangkaensis* n. sp., *Joculator nucleus* n. sp., *Joculator diversus* n. sp., *Marshallopsis sabellii* n. sp., *Specula agamennonei* n. sp., *Synthopsis dibellai* n. sp., *Synthopsis russoi* n. sp.); for other reported species is extended the distribution range in the Indo-Pacific area.

Key Word

Mollusca, Gastropoda, Triphoroidea, Cerithiopsidae, Indonesia, North Sulawesi, Bangka Is.

Riassunto

In questo contributo, sono rappresentate quarantasei specie di Cerithiopsidae provenienti dall'isola di Bangka a nord di Sulawesi (Indonesia), di cui 38 sono già conosciute e 8 risultano nuove per la scienza. Sono descritte (*Horologica forlii* n. sp., *Joculator bangkaensis* n. sp., *Joculator nucleus* n. sp., *Joculator diversus* n. sp., *Marshallopsis sabellii* n. sp., *Specula agamennonei* n. sp., *Synthopsis dibellai* n. sp., *Synthopsis russoi* n. sp.); per le altre specie segnalate viene ampliata la loro distribuzione nell'area indopacifica.

Parola chiave

Mollusca, Gastropoda, Triphoroidea, Cerithiopsidae, Indonesia, Nord Sulawesi, Bangka Is.

Introduction

Continues in this paper the identification of micro-molluscs of the Family Cerithiopsidae increasing the list of reported species from the Indo-Pacific area, see: Hedley, 1909 Laseron, 1951; 1956; Marshall, 1978; Nützel, 1988; Jay & Drivas, 2002; Cecalupo & Perugia, 2012; 2103; 2014^a, 2014^b; 2016, 2017^a, 2017^b.

Wanting to make a further contribution to our previous papers we did our research on a little-known area of the Western Pacific, between Celebes Sea and Moluccas Sea, exactly on Bangka Pulau, an island at north Sulawesi (Indonesia).

Materials and Methods

The reported shells from Bangka Pulau has been selected examining sandy sediment collected at low tide at depth 1.5-3 m, in November 2015 and 2016. The material was collected on a sandy bank (1°45'N-125°09'E), with some areas covered with algae and other with scattered coral blocks, and at several points along the reef in the south side of the island. (between 1°49'N - 125°06'E e 1°44'N - 125°08'E).

For the classification of the new species the more important characteristic is the protoconch, are also reported the known species without protoconch but with characteristics which allow us to easily identification.

Acronyms and abbreviations

auct. auctores (lat.). authors
cf near/resembling
et al. *et alii* (lat.), and others
ESEM - Environmental Scanning Electron Microscope.
MNHN - Muséum National d'Histoire Naturelle, Paris, France.
n. sp. new species
spms specimen (s)

Systematics

The systematic is that adopted by Bouchet & Rocroi (2005) up to subfamilies. The distribution of genera in subfamilies is after Marshall (1978), which remains provisional until data on the soft parts will be available.

Family Cerithiopsidae H. Adams & A.
Adams, 1853
Genus *Horologica* Laseron, 1956
[Type species *Horologica bicolor* Laseron, 1956]

Horologica forlii n. sp.
(Fig. 1. A-C)

Type material

Holotype (MNHN-IM-2000-33433), 2.75 x 0.87 mm, protoconch 0.60 x 0.25 mm (broken after ESEM).

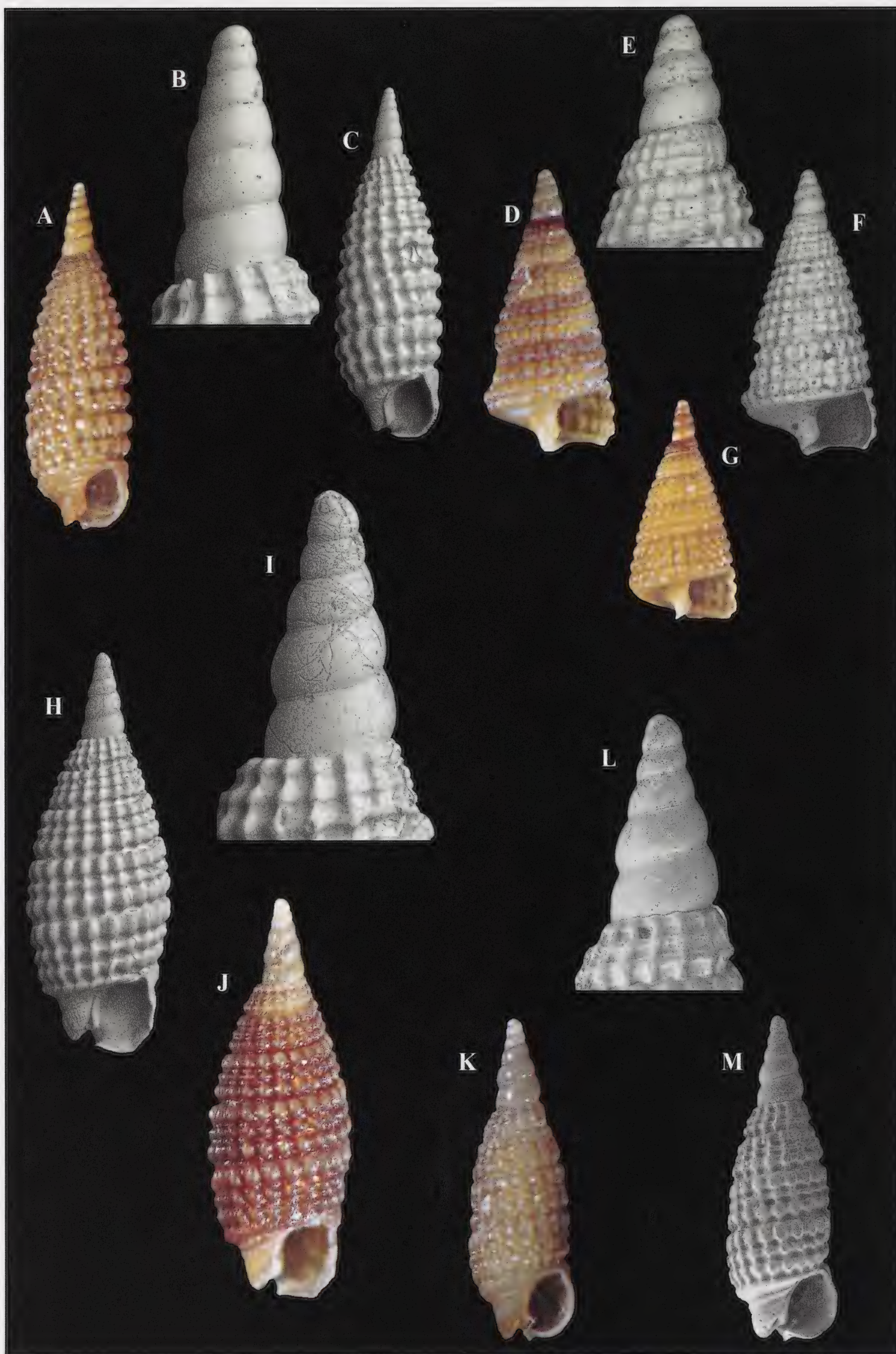


Fig. 1. A-C. *Horologica forlii* n. sp. (MNHN-IM-2000-33433): 2.75 x 0.87 mm, protoconch 0.60 x 0.25 mm (broken after ESEM); **D-F.** *Joculator bangkaensis* n. sp. (MNHN-IM-2000-33434): 1.91 x 0.97 mm, protoconch 0.45 x 0.34 mm; **G.** Vanuatu, Espiritu Santo Is., Malo Is., 5-7 m, dim. 1.89 x 1.02 mm; **H-J.** *Joculator nucleus* n. sp. (MNHN-IM-2000-33435): 2.50 x 0.97 mm, protoconch 0.53 x 0.26 mm (broken after ESEM); **K-M.** (MNHN-IM-2000-33436), *Joculator diversus* n. sp. (MNHN-IM-2000-33436): 1.82 x 0.62 mm, protoconch 0.60 x 0.27 mm.

Fig. 1. A-C. *Horologica forlii* n. sp. (MNHN-IM-2000-33433): 2,75 x 0,87 mm, protoconca 0,60 x 0,25 mm, (rotta dopo ESEM); **D-F.** *Joculator bangkaensis* n. sp. (MNHN-IM-2000-33434): 1,91 x 0,97 mm, protoconca 0,45 x 0,34 mm; **G.** Vanuatu, Is. Espiritu Santo, Is. Malo, 5-7 m, dim. 1,89 x 1,02 mm; **H-J.** *Joculator nucleus* n. sp. (MNHN-IM-2000-33435): 2,50 x 0,97 mm, protoconca 0,53 x 0,26 mm (rotta dopo ESEM); **K-M.** *Joculator diversus* n. sp. (MNHN-IM-2000-33436): 1,82 x 0,62 mm, protoconca 0,60 x 0,27 mm.

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Bangka Is., spm 1, reef.

Description of holotype

Shell small, conical inflated with slightly constricted base, suture moderately impressed. Protoconch acute, slender and conical of 5.5 smooth convex whorls, apex spherical. Teleoconch of 6.5 whorls. Reticulate sculpture of 2 spiral cords, nearly equal in size, crossed by weaker axial ribs (16 on the last whorl); in the last whorl the first cord is larger; interval larger than spirals. Strong beads at each intersection; a fourth narrower beaded cord at the base of the last whorl. Under ESEM the limit between the base of the shell and the columella is highlighted by a weak cord followed by a thin furrow. Columella short, obliquely truncate, with thin crisp growth lines throughout. A clear columellar callus bordering the sub-circular aperture. Siphonal canal wide, well defined. Color dark orange with beads paler.

Comparison

Horologica forlii n. sp. is compared with *Horologica infuscata* Cecalupo & Perugia, 2012 from Central Philippines having similar protoconch from which it differs for the teleoconch more inflated, sculpture with less impressed sutures, interspaces narrower, spiral lightly larger, beads more rounded, last whorl without the thin third intermediate spiral and color dark orange vs dark brown in *H. infuscata*.

Etymology

Dedicated to Maurizio Forli of Prato (Italy), Member of SIM (Società Italiana di Malacologia).

Genus *Joculator* Hedley, 1909

[Type species *Cerithiopsis ridicula* Watson, 1886]

Joculator bangkaensis n. sp.

(Fig. 1. D-G)

Type material

Holotype (MNHN-IM-2000-33434), 1.91 x 0.97 mm, protoconch 0.45 x 0.34 mm.

Figured specimen

Vanuatu, Espiritu Santo Is., Malo Is., 5-7 m, dim. 1.89 x 1.02 mm, fig. 1G.

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Spm 1, sandy bank, spm 1, Vanuatu, Espiritu Santo Is., W coast of Malo Is., 5-7 m.

Description of holotype

Shell juvenile, incomplete, perfectly conical with ratio H/L 0.50, sutures moderately impressed. Protoconch conical of 4.5 smooth convex whorls; color brownish, semitransparent. Teleoconch of 5 whorls; reticulate sculpture of 3 spiral cords, equal in size, crossed by weaker axial ribs, about 22 on last whorl; squared beads at each intersection; another narrow spiral emerging from insertion of outer lip. Aperture incomplete. Color brown.

Comparison

This species is juvenile but shows very interesting specific characters; has already been illustrated by Cecalupo & Perugia (2013: 161, pl. 35, fig. A), from Vanuatu (W coast of Malo Is.), among unidentified species. It is compared with *Clathropsis* sp. Cecalupo & Perugia (2012: 166, pl. 40, fig. A), from Philippines (Pamilacan Is.), similar in color but having a different sculpture of the teleoconch with only 2 spiral cords.

Etymology

From the type locality.

Joculator nucleus n. sp.

(Fig. 1. H-J)

Type material

Holotype (MNHN-IM-2000-33435), 2.50 x 0.97 mm, protoconch 0.53 x 0.26 mm (broken after ESEM).

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Bangka Is., spm 1, reef.

Description of holotype

Shell small, oval elongated with constricted base. Protoconch conical, slender, acute of 4.5 smooth convex whorls; color yellowish, semitransparent. Teleoconch of 5 whorls. Reticulate sculpture of 3 spiral cords (1st stronger, 2nd narrower), crossed by weaker axial ribs, 17-18 on last whorl. Beads at each intersection; another narrow beaded spiral emerging from insertion of outer lip. Sutures moderately impressed. Columella short and broad, obliquely truncate crossed by thin crisp threads; under ESEM limit between base and columella highlighted by clear angle. A ridge bordering circular aperture; anal sulcus and siphonal canal wide and well defined. Color light brown, beads paler.

Comparison

Joculator nucleus n. sp. is compared with *Joculator variabilis* Cecalupo & Perugia, 2012 from Philippines similar in the shape and in the sculpture of the teleoconch but different having a protoconch shorter and a background color yellow.

Etymology

For the shape of the shell: latin nucleus in English hazel.

***Joculator diversus* n. sp.**
(Fig. 1. K-M)

Type material

Holotype (MNHN-IM-2000-33436), dim 1.82 x 0.62 mm, protoconch 0.60 x 0.27 mm.

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Bangka Is., spm 1, reef.

Description of holotype

Shell small, oval elongated with constricted base; sutures moderately impressed. Protoconch conical, acute of 5.5 smooth convex whorls; color yellowish, semitransparent. Teleoconch of 4 whorls; reticulate sculpture of 3 spiral cords (1st stronger, 2nd very narrower), crossed by weaker axial ribs, 16-17 on last whorl; beads at each intersection; another narrow beaded spiral emerging from insertion of outer lip. Columella short and broad, obliquely truncate crossed by thin crisp threads; under ESEM limit between base and columella highlighted by

a cord. A ridge bordering circular aperture; anal sulcus and siphonal canal well defined. Color pale orange.

Comparison

Joculator diversus n. sp. is compared with *Joculator similans* Cecalupo & Perugia, 2012 from Philippines having a similar teleoconch with 2nd spiral cord very narrower but with a different protoconch, more slender and with *Joculator autumnus* Cecalupo & Perugia, 2016 from Red Sea (Egypt), having similar protoconch but shorter of only 4.4 whorls and a different teleoconch with a sculpture of equal spiral cords.

Etymology

Latin diversus, a - um in English different.

Genus *Marshallopsis* Cecalupo & Perugia, 2012
[Type species *Marshallopsis albachiarae* Cecalupo & Perugia, 2012]

***Marshallopsis sabellii* n. sp.**
(Fig. 2. A-C)

Type material

Holotype (MNHN-IM-2000-33437), 2.07 x 0.80 mm, protoconch 0.57 x 0.22 mm.
paratype 1 - (juv. sp.), 1.37 x 0.75 mm, protoconch 0.56 x 0.22 mm (Perugia coll.).

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Bangka Is., spms 2, reef.

Description of holotype

Shell of very small size, oval elongated with constricted last whorl; sutures moderately impressed. Protoconch short of 4.5 convex whorls, apex rounded; 1.5 apical whorls smooth, next smooth on upper half with sculpture of 16-18 thin prosocline riblets, regularly spaced, on lower half. Color yellowish, semitransparent. Teleoconch of 4 whorls with reticulate sculpture of 2 spiral cords, the 1st larger, becoming 3 on last whorl, crossed by axial ribs (14 on last whorl). Interval wider than the spirals. Strong beads at each intersection. A 3th narrow beaded cord emerging from insertion of outer lip. Columella short with a weak cord and a surface crossed by thin growth lines. Columellar callus bordering a sub-circular aperture. Siphonal canal and anal sulcus well de-

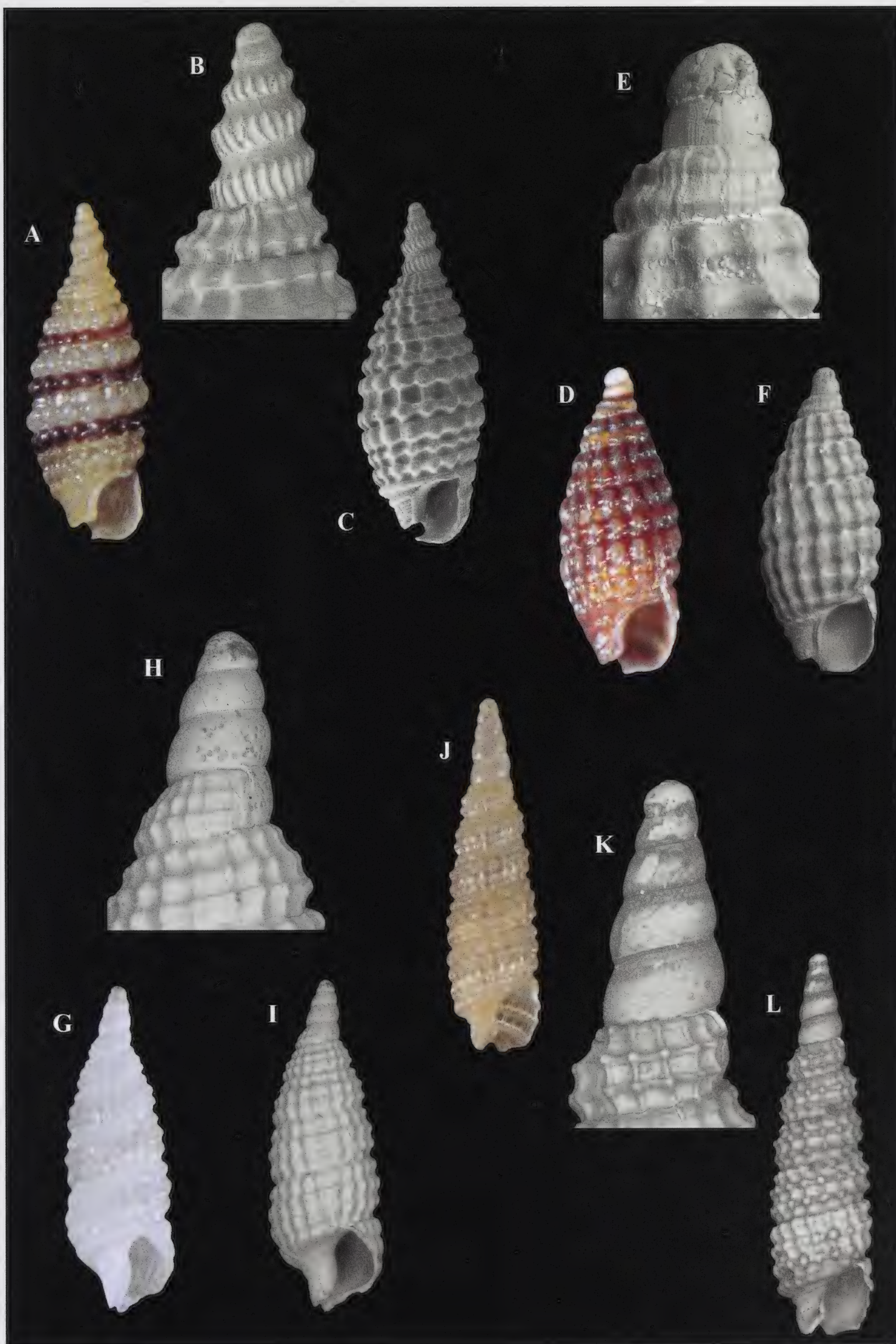


Fig. 2. A-C. *Marshallopsis sabellii* n. sp. (MNHN-IM-2000-33437): 2.07 x 0.80 mm, protoconch 0.57 x 0.22 mm; **D-F.** *Specula agamennonei* n. sp. (MNHN-IM-2000-33438): 1.92 x 0.80 mm, protoconch 0.27 x 0.22 mm (broken after ESEM); **J-L.** *Synthopsis dibellai* n. sp. (MNHN-IM-2000-33439): 2.22 x 0.65 mm, protoconch 0.71 x 0.27 mm; **G-I.** *Synthopsis russoi* n. sp. (MNHN-IM-2000-33440): 2.22 x 0.81 mm, protoconch 0.46 x 0.35 mm.

Fig. 2. A-C. *Marshallopsis sabellii* n. sp. (MNHN-IM-2000-33437): 2,07 x 0,80 mm, protoconca 0,57 x 0,22 mm; **D-F.** *Specula agamennonei* n. sp. (MNHN-IM-2000-33438): 1,92 x 0,80 mm, protoconca 0,27 x 0,22 mm (rotta dopo ESEM); **J-L.** *Synthopsis dibellai* n. sp. (MNHN-IM-2000-33439): 2,22 x 0,65 mm, protoconca 0,71 x 0,27 mm; **G-I.** *Synthopsis russoi* n. sp. (MNHN-IM-2000-33440): 2,22 x 0,81 mm, protoconca 0,46 x 0,35 mm.

fined. Color yellowish with 1st spiral cord whitish, 2nd red brown.

Comparison

Marshallopsis sabellii n. sp. is compared with *Marshallopsis jolandae* Cecalupo & Perugia, 2013 reported from Vanuatu and N. Caledonia which differs mainly in size and white color. Many *Horologica* have similar color, *Horologica rinaldii* Cecalupo & Perugia, 2013, is the most like and having a very fragile protoconch can be easily confused with *Marshallopsis sabellii* n. sp.

Etymology

Dedicated to Bruno Sabelli of Bologna, Scientific Director of SIM (Società Italiana di Malacologia).

Genus *Specula* Finlay, 1926

[Type species *Cerithiopsis styliformis* Suter, 1980]

Specula agamennonei n. sp. (Fig. 2. D-F)

Type material

Holotype (MNHN-IM-2000-33438), 1.92 x 0.80 mm, protoconch 0.27 x 0.22 mm (broken after ESEM).

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Bangka Is., spm 1, reef.

Description of holotype

Shell of very small size, oval elongated with constricted last whorl; sutures moderately impressed. Protoconch short of 2.5 smooth convex whorls, apex rounded. Color whitish. Teleoconch of 5 whorls with reticulate sculpture of 2 spiral cords, the first larger in the last whorl, crossed by axial ribs (16 on the last whorl). Interval wider than the spirals; strong beads at each intersection. A third narrow beaded cord, emerging from the suture, is at the base of the last whorl. Limit between columella and base highlighted by weak cord; columella short with surface crossed by thin growth lines. Columella short with a weak cord and a surface crossed by thin growth lines. Columellar callus bordering a sub-circular aperture; siphonal canal and anal sulcus well defined. Color red-brown.

Comparison

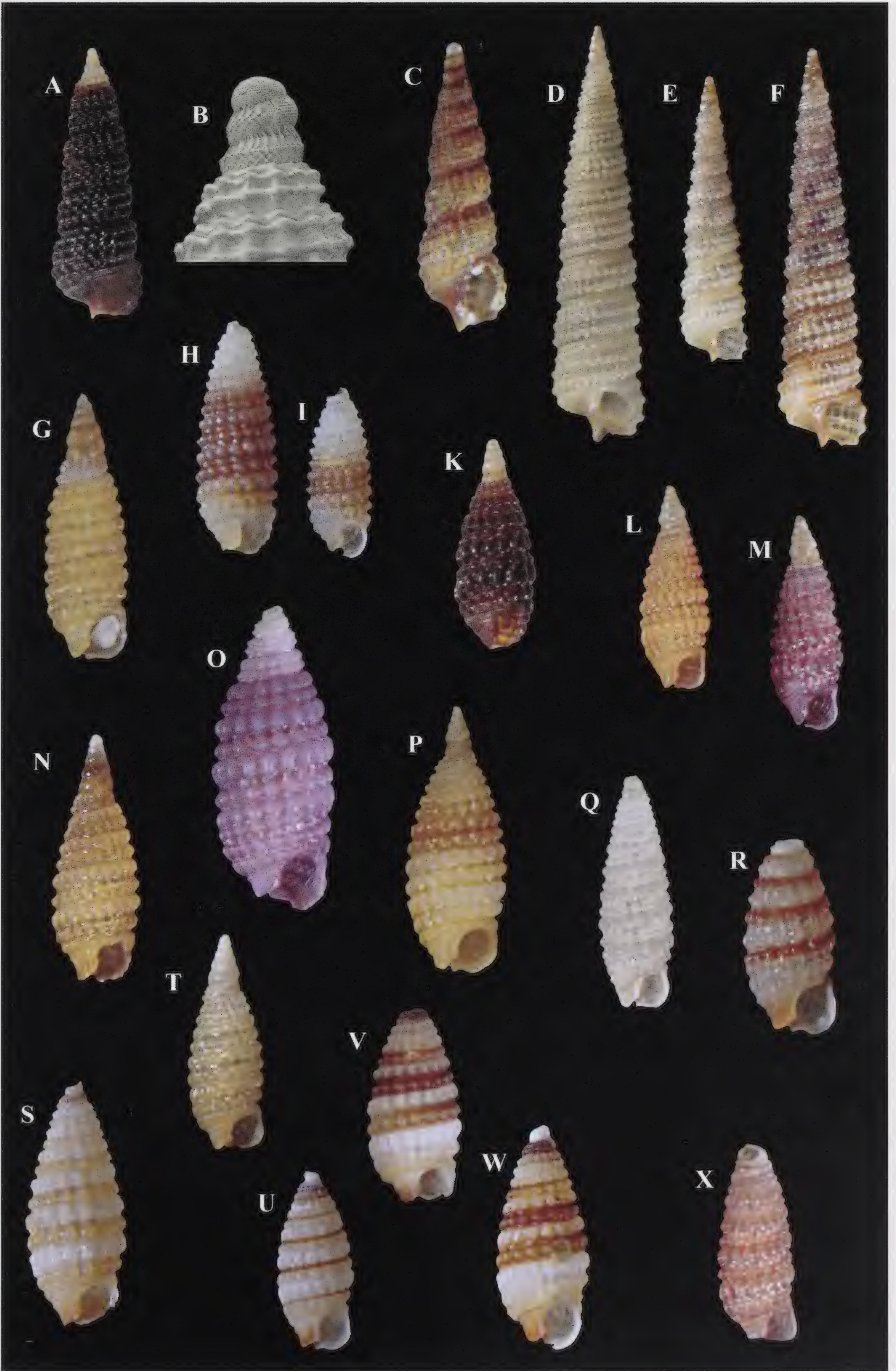
Specula agamennonei n. sp. is compared with *Specula albengai*, *Specula vivilfarei* both Cecalupo & Perugia, 2013 from Vanuatu, *Specula dimatteoi* Cecalupo & Perugia, 2017 from New Caledonia and *Joculator* sp in Nutzel 1998:42, pl. 5, figs. I-K, all easily distinguishable having 3 spiral cords on the teleoconch.

Etymology

Dedicated to Franco Agamennone of Pescara (Italy), treasurer of SIM (Società Italiana di Malacologia).

Fig. 3. A, B. *Cerithiopsidella ziliolii* Cecalupo & Perugia, 2012: **A.** 4.61 x 1.60 mm, sandy bank; **B.** protoconch, sandy bank; type locality, Panglao Is., Philippines. **C.** *Clathropsis quaterstriata* Cecalupo & Perugia, 2012: 2.35 x 0.72 mm, reef; type locality, Pamilacan Is., Philippines. **D.** *Clathropsis multispirae* Cecalupo & Perugia, 2012: 7.54 x 1.65 mm, reef; type locality, Panglao Is., Philippines. **E, F.** *Clathropsis poppearum* Cecalupo & Perugia, 2012: **E.** 4.25 x 1.05 mm; **F.** 7.21 x 1.18 mm, reef, sandy bank; type locality, Mactan Is., Philippines. **G.** *Horologica* cf *acuta* Cecalupo & Perugia, 2013: 2.00 x 0.65 mm, reef; type locality, NW Tytyba Island, Vanuatu. **H, I.** *Horologica amoena* Cecalupo & Perugia, 2013: **H.** 2.37 x 0.87 mm; **I.** 1.75 x 0.68 mm, reef; type locality, Oyster Island, Vanuatu. **K.** *Horologica anisocorda* Jay & Drivas, 2002: 1.93 x 0.75 mm, reef, sandy bank; type locality, Saint-Gilles-les-Bains, Reunion Island. **L, M.** *Horologica diffusa* Cecalupo & Perugia, 2012: **L.** 1.97 x 0.72 mm; **M.** 2.02 x 0.68 mm, sandy bank; type locality, Cebu Is., Philippines. **N.** *Horologica gregaria* Cecalupo & Perugia, 2012: 2.00 x 0.72 mm, sandy bank and reef; type locality, Mactan Is., Philippines. **O.** *Horologica* cf *gwenaelae* Cecalupo & Perugia, 2013: 3.05 x 1.23 mm, sandy bank; type locality, S Turtle Island, Vanuatu. **P.** *Horologica jayi* Cecalupo & Perugia, 2012: 2.68 x 0.95 mm, reef; type locality, Mactan Is., Philippines. **Q.** *Horologica loyaltyensis* Cecalupo & Perugia, 2017: 2.95 x 0.98 mm, reef; type locality, Loyalty Is. Lifou, Santa Bay of Huca Hutigjé Is., New Caledonia. **R.** *Horologica marianii* Cecalupo & Perugia, 2012: 1.43 x 0.60 mm, reef; type locality, Mactan Is., Philippines. **S.** *Horologica micalae* Cecalupo & Perugia, 2012: 2.83 x 1.24 mm, reef; type locality, Panglao Is., Philippines. **T.** *Horologica nodosa* Cecalupo & Perugia, 2012: 1.95 x 0.72 mm, reef, sandy bank; type locality, Bohol Is., Philippines. **U-W.** *Horologica* cf *magnifica* Cecalupo & Perugia, 2012: **U.** 2.27 x 1.05 mm; **V.** 2.26 x 1.07 mm; **W.** 2.31 x 1.12 mm, reef; type locality, Panglao Is., Philippines. **X.** *Horologica* sp. (under study): 1.67 x 0.65 mm, sandy bank.

Fig. 3. A, B. *Cerithiopsidella ziliolii* Cecalupo & Perugia, 2012: **A.** 4,61 x 1,60 mm, argine sabbioso; **B.** protoconca, argine sabbioso; località tipo, Is. Panglao, Filippine. **C.** *Clathropsis quaterstriata* Cecalupo & Perugia, 2012: 2,35 x 0,72 mm, reef; località tipo, Is. Pamilacan, Filippine. **D.** *Clathropsis multispirae* Cecalupo & Perugia, 2012: 7,54 x 1,65 mm, reef; località tipo, Is. Panglao, Filippine. **E, F.** *Clathropsis poppearum* Cecalupo & Perugia, 2012: **E.** 4,25 x 1,05 mm; **F.** 7,21 x 1,18 mm, reef, argine sabbioso; località tipo, Is. Mactan, Filippine. **G.** *Horologica* cf *acuta* Cecalupo & Perugia, 2013: 2,00 x 0,65 mm, reef; località tipo, NW Isola Tytyba, Vanuatu. **H, I.** *Horologica amoena* Cecalupo & Perugia, 2013: **H.** 2,37 x 0,87 mm; **I.** 1,75 x 0,68 mm, reef; località tipo, Isola Oyster, Vanuatu. **K.** *Horologica anisocorda* Jay & Drivas, 2002: 1,93 x 0,75 mm, reef, argine sabbioso; località tipo, Saint-Gilles-les-Bains, Isola Reunion. **L, M.** *Horologica diffusa* Cecalupo & Perugia, 2012: **L.** 1,97 x 0,72 mm; **M.** 2,02 x 0,68 mm, argine sabbioso; località tipo, Is. Cebu, Filippine. **N.** *Horologica gregaria* Cecalupo & Perugia, 2012: 2,00 x 0,72 mm, argine sabbioso e reef; località tipo, Is. Mactan, Filippine. **O.** *Horologica* cf *gwenaelae* Cecalupo & Perugia, 2013: 3,05 x 1,23 mm, argine sabbioso; località tipo, S Isola Turtle, Vanuatu. **P.** *Horologica jayi* Cecalupo & Perugia, 2012: 2,68 x 0,95 mm, reef; località tipo, Is. Mactan, Filippine. **Q.** *Horologica loyaltyensis* Cecalupo & Perugia, 2017: 2,95 x 0,98 mm, reef; località tipo, Is. Loyalty Lifou, Santa Bay of Is. Huca Hutigjé, New Caledonia. **R.** *Horologica marianii* Cecalupo & Perugia, 2012: 1,43 x 0,60 mm, reef; località tipo, Is. Mactan, Filippine. **S.** *Horologica micalae* Cecalupo & Perugia, 2012: 2,83 x 1,24 mm, reef; località tipo, Is. Panglao, Filippine. **T.** *Horologica nodosa* Cecalupo & Perugia, 2012: 1,95 x 0,72 mm, reef, argine sabbioso; località tipo, Is. Bohol, Filippine. **U-W.** *Horologica* cf *magnifica* Cecalupo & Perugia, 2012: **U.** 2,27 x 1,05 mm; **V.** 2,26 x 1,07 mm; **W.** 2,31 x 1,12 mm, reef; località tipo, Is. Panglao, Filippine. **X.** *Horologica* sp. (under study): 1,67 x 0,65 mm, argine sabbioso.



Specula puillandrei Cecalupo & Perugia, 2013
(Fig. 5. K-M)

Figured specimen

Dim. 3.33 x 1.23 mm, protoconch 0.37 x 0.25 mm (broken after ESEM), Indonesia - Bangka Is., (Perugia coll.).

Type locality

Vanuatu, Espiritu Santo Is., NW coast of MaloIs., 78-91 m.

Distribution

Indonesia, Vanuatu.

Material examined

Indonesia, N Sulawesi, Bangka Pulau, sandy bank, 1-3 m, spm 1.

Remarks

The holotype of *Specula puillandrei* is smaller with a protoconch slightly shorter, smooth, apex granulous; colour yellow with the first spiral darker.

Genus *Synthopsis* Laseron, 1956
[Type species *Synthopsis cylindrica* Laseron, 1956]

Synthopsis dibellai n. sp.
(Fig. 2. J-L)

Type material

Holotype (MNHN-IM-2000-33439), 2.22 x 0.65 mm, protoconch 0.71 x 0.27 mm.

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Distribution

Known only from the type locality.

Material examined

Bangka Is., spm 1, reef.

Description of holotype

Shell medium, narrowly conical (ratio H/L 0.29), sutures distinct; color pale yellow, near semitransparent. Protoconch conical, with same inclination of spire, of 5.5 smooth, convex whorls; apex rounded. Teleoconch of 5 slightly convex whorls; reticulate sculpture of 3 spiral cords (1st immediately after suture) crossed by axial ribs, 18 on last whorl; bead at each intersection; cords and ribs nearly equal in size; a 4th beaded cord at the base of last whorl emerging from insertion of outer lip. Limit between base and columella highlighted by angle and weak cord. Columella short, obliquely truncate, with a surface crossed by thin crisp threads. A columellar callus bordering the oval aperture with wide siphonal canal wide and anal sulcus well defined.

Comparison

Synthopsis dibellai n. sp. is compared with two species rather similar *Synthopsis vallesi* Cecalupo & Perugia, 2013 from Vanuatu and *Synthopsis richeri* Cecalupo & Perugia, 2017 from New Caledonia, which differ by having more acuminate shape with less convex whorls and a whitish protoconch.

Etymology

Dedicated to Antonio Di Bella of Patti, Messina (Italy), member of SIM (Società Italiana di Malacologia).

Synthopsis russoi n. sp.
(Fig. 2. G-I)

Type material

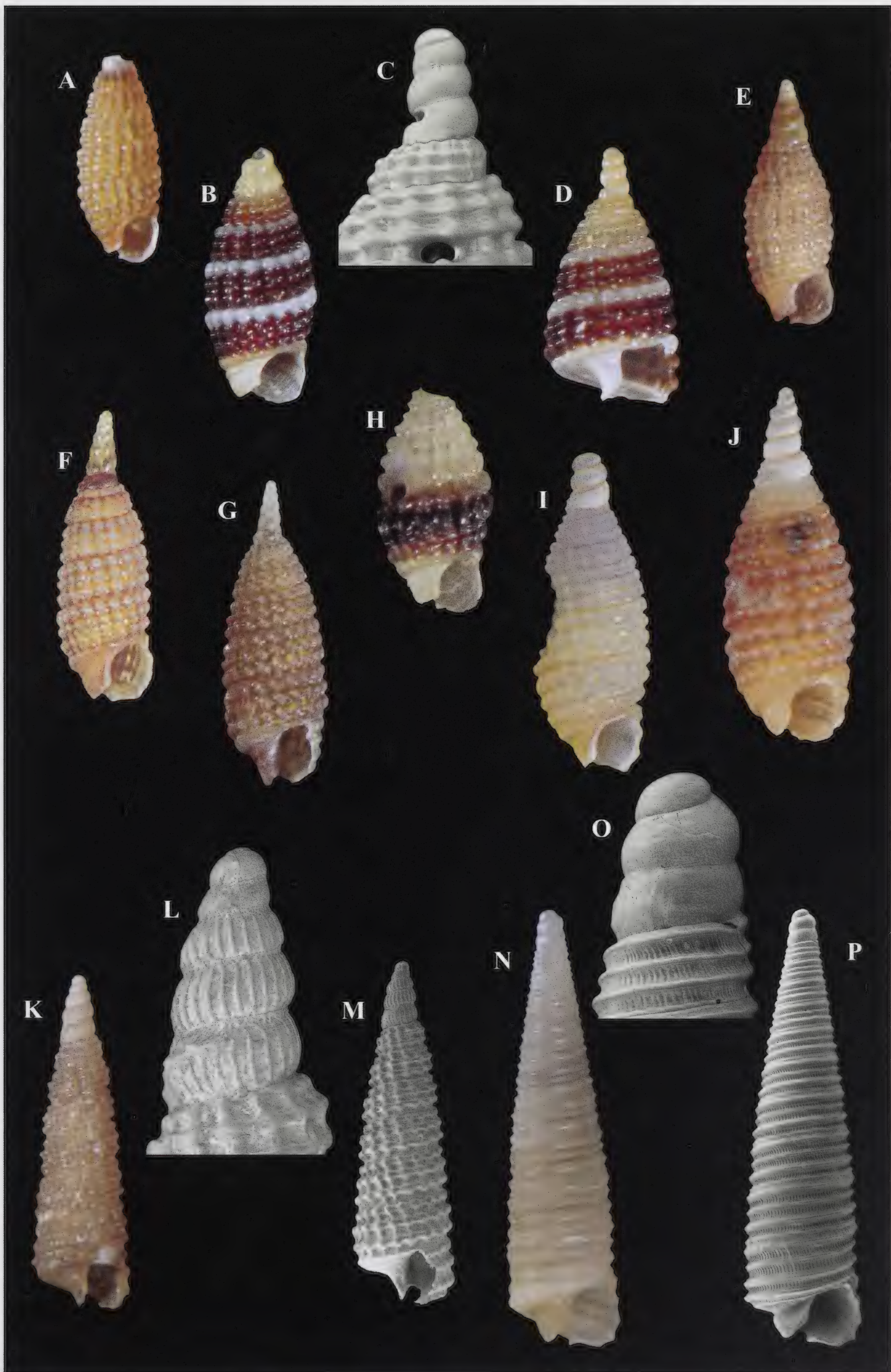
Holotype (MNHN-IM-2000-33440), 2.22 x 0.81 mm, protoconch 0.46 x 0.35 mm.

Type locality

Indonesia, N. Sulawesi, Bangka Is.

Fig. 4. A. *Joculator acuminatus* Cecalupo & Perugia, 2012: 1.63 x 0.70 mm, reef; type locality, Panglao Is., Philippines. **B-D.** *Joculator arduini* Cecalupo & Perugia, 2012: **B.** 2.11 x 0.92 mm; **C.** 0.50 x 0.23 mm; **D.** 1.12 x 0.67 mm, sandy bank; type locality, Panglao Is., Philippines. **E.** *Joculator lividus* Cecalupo & Perugia, 2012: 1.85 x 0.72 mm, reef; type locality, Panglao Is., Philippines. **F, G.** *Joculator laguncula* (Cecalupo & Perugia, 2012): **F.** 2.12 x 0.70 mm; **G.** 2.53 x 0.76 mm, reef; type locality, Pamilacan Is., Philippines. **H.** *Marshallopsis* cf *gattellii* Cecalupo & Perugia, 2012: 1.77 x 0.92 mm, reef; type locality, Bohol Is., Philippines. **I.** *Prolixodens inopinata* (Cecalupo & Perugia, 2012): 2.60 x 0.93 mm, reef; type locality, Balicasag Is., Philippines. **J.** *Prolixodens lutea* (Cecalupo & Perugia, 2012): 2.66 x 0.97 mm, reef and sandy bank; type locality, Pamilacan Is., Philippines. **K-M.** *Prolixodens* cf *mascarensis* (Jay & Drivas, 2002): **K, M** 2.47 x 0.73 mm; **L.** protoconch 0.50 x 0.23 mm, sandy bank; type locality, Saint-Gilles-les-Bains, Reunion Island. **N-P.** *Seila varenii* Cecalupo & Perugia, 2012: **N, P.** 6.26 x 1.50 mm; **O.** protoconch 0.57 x 0.40 mm, sandy bank; type locality, Mactan Is., Philippines.

Fig. 4. A. *Joculator acuminatus* Cecalupo & Perugia, 2012, 1,63 x 0,70 mm, reef; località tipo, Is. Panglao, Filippine. **B-D.** *Joculator arduini* Cecalupo & Perugia, 2012: **B.** 2,11 x 0,92 mm; **C.** 0,50 x 0,23 mm; **D.** 1,12 x 0,67 mm, argine sabbioso; località tipo, Is. Panglao, Filippine. **E.** *Joculator lividus* Cecalupo & Perugia, 2012: 1,85 x 0,72 mm, reef; località tipo, Panglao Is., Filippine. **F, G.** *Joculator laguncula* (Cecalupo & Perugia, 2012): **F.** 2,12 x 0,70 mm; **G.** 2,53 x 0,76 mm, reef; località tipo, Is. Pamilacan, Filippine. **H.** *Marshallopsis* cf *gattellii* Cecalupo & Perugia, 2012: 1,77 x 0,92 mm, reef; località tipo, Is. Bohol, Filippine. **I.** *Prolixodens inopinata* (Cecalupo & Perugia, 2012), 2,60 x 0,93 mm, reef; località tipo, Is. Balicasag, Filippine. **J.** *Prolixodens lutea* (Cecalupo & Perugia, 2012): 2,66 x 0,97 mm, reef e argine sabbioso; località tipo, Is. Pamilacan, Filippine. **K-M.** *Prolixodens* cf *mascarensis* (Jay & Drivas, 2002): **K, M** 2,47 x 0,73 mm; **L.** protoconca 0,50 x 0,23 mm, argine sabbioso; località tipo, Saint-Gilles-les-Bains, Isole Reunion. **N-P.** *Seila varenii* Cecalupo & Perugia, 2012: **N, P.** 6,26 x 1,50 mm; **O.** protoconch 0,57 x 0,40 mm, argine sabbioso; località tipo, Is. Mactan, Filippine.



Distribution

Known only from the type locality.

Material examined

Bangka Is., spm 1, sandy bank.

Description of holotype

Shell small, conical inflated, sutures impressed, aperture damaged, color plain white, semitransparent. Protoconch conical of 3.5-4 smooth convex whorls, embryonic whorl spherical. Teleoconch of 5 whorls; reticulate sculpture of 3 equal spiral cords crossed by weaker axial ribs (about 20 on last whorl); rectangular beads at each intersection. A fourth beaded cord emerging from insertion of outer lip; limit between base and columella highlighted by angle. Columella short, crossed by thin crinkled threads throughout; a ridge bordering the damaged aperture.

Comparison

Synthopsis russoi n. sp. can only be confused with *Specula molini* Cecalupo & Perugia, 2013, from Vanuatu and reported also from New Caledonia, for shape and color but the latter has a protoconch very different.

Etymology

Dedicated to Paolo Russo of Venice (Italy), President of SIM (Società Italiana di Malacologia).

Remarks

Doubts about generic attribution.

OTHER MATERIAL EXAMINED FROM BANGKA ISLAND

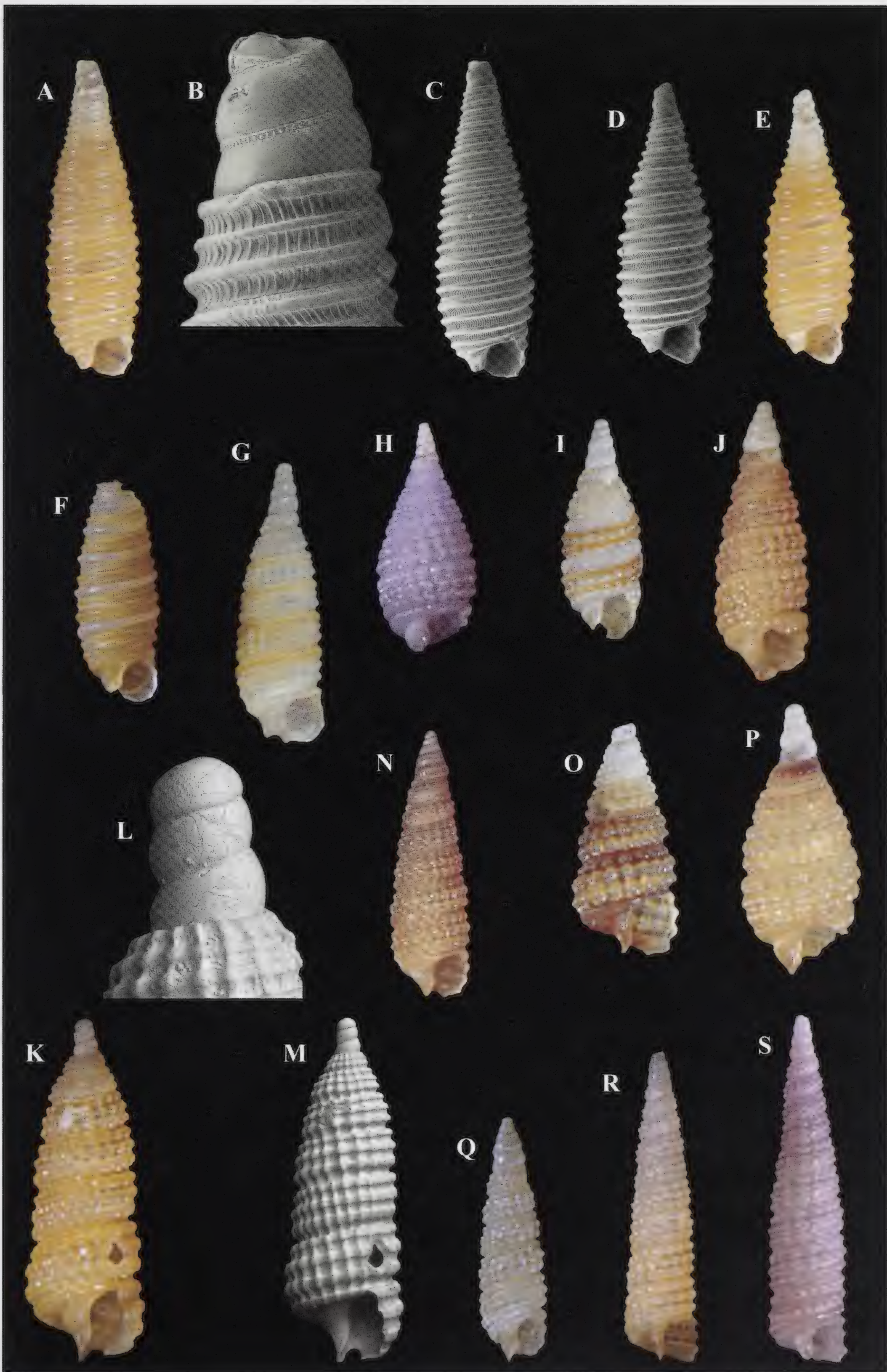
Images Fig. 3.

A, B. *Cerithiopsidella ziliolii* Cecalupo & Perugia, 2012: **A.** 4.61

- C.** *Clathropsis quaterstriata* Cecalupo & Perugia, 2012: 2.35 x 0.72 mm, reef; type locality, Pamilacan Is., Philippines.
- D.** *Clathropsis multispirae* Cecalupo & Perugia, 2012: 7.54 x 1.65 mm, reef; type locality, Panglao Is., Philippines.
- E, F.** *Clathropsis poppearum* Cecalupo & Perugia, 2012: **E.** 4.25 x 1.05 mm; **F.** 7.21 x 1.18 mm, reef, sandy bank; type locality, Mactan Is., Philippines.
- G.** *Horologica* cf *acuta* Cecalupo & Perugia, 2013: 2.00 x 0.65 mm, reef; type locality, NW Tytyba Island, Vanuatu.
- H, I.** *Horologica amoena* Cecalupo & Perugia, 2013: **H.** 2.37 x 0.87 mm; **I.** 1.75 x 0.68 mm, reef; type locality, Oyster Island, Vanuatu.
- K.** *Horologica anisocorda* Jay & Drivas, 2002: 1.93 x 0.75 mm, reef, sandy bank; type locality, Saint-Gilles-les-Bains, Reunion Island.
- L, M.** *Horologica diffusa* Cecalupo & Perugia, 2012: **L.** 1.97 x 0.72 mm; **M.** 2.02 x 0.68 mm, sandy bank; type locality, Cebu Is., Philippines.
- N.** *Horologica gregaria* Cecalupo & Perugia, 2012: 2.00 x 0.72 mm, sandy bank and reef; type locality, Mactan Is., Philippines.
- O.** *Horologica* cf *gwenaeliae* Cecalupo & Perugia, 2013: 3.05 x 1.23 mm, sandy bank; type locality, S Turtle Island, Vanuatu.
- P.** *Horologica jayi* Cecalupo & Perugia, 2012: 2.68 x 0.95 mm, reef; type locality, Mactan Is., Philippines.
- Q.** *Horologica loyaltyensis* Cecalupo & Perugia, 2017: 2.95 x 0.98 mm, reef; type locality, Loyalty Is. Lifou, Santa Bay of Huca Hutigjé Is., New Caledonia.
- R.** *Horologica marianii* Cecalupo & Perugia, 2012: 1.43 x 0.60 mm, reef; type locality, Mactan Is., Philippines.
- S.** *Horologica micaelae* Cecalupo & Perugia, 2012: 2.83 x 1.24 mm, reef; type locality, Panglao Is., Philippines.
- T.** *Horologica nodosa* Cecalupo & Perugia, 2012: 1.95 x 0.72 mm, reef, sandy bank; type locality, Bohol Is., Philippines.
- U-W.** *Horologica* cf *magnifica* Cecalupo & Perugia, 2012: **U.** 2.27 x 1.05 mm; **V.** 2.26 x 1.07 mm; **W.** 2.31 x 1.12 mm, reef; type locality, Panglao Is., Philippines.
- X.** *Horologica* sp. (under study): 1.67 x 0.65 mm, sandy bank.

Fig. 5. A-E. *Seila mactanensis* Cecalupo & Perugia, 2012: **A, C.** 3.65 x 1.13 mm; **D., E.** 3.23 x 1.10 mm, sandy bank and reef; type locality, Mactan Is., Punta Engaño, Philippines. **F.** *Seila silviae* Cecalupo & Perugia, 2012: 2.42 x 0.93 mm, sandy bank and reef; type locality, Panglao Is., Philippines. **G.** *Synthopsis albachiaerae* Cecalupo & Perugia, 2012, 2.46 x 0.82 mm, reef; type locality, Bohol Is., Philippines. **H.** *Synthopsis ampulla* Cecalupo & Perugia, 2012, 1.98 x 0.89 mm, sandy bank; type locality, Balicasag Is., Philippines. **I.** *Synthopsis bicincta* Cecalupo & Perugia, 2012, 1.87 x 0.70 mm, sandy bank and reef; type locality, Balicasag Is., Philippines. **J.** *Synthopsis impedita* Cecalupo & Perugia, 2012, 2.27 x 0.72 mm, sandy bank and reef; type locality, Panglao Is., Philippines. **K-M.** *Specula puillandrei* Cecalupo & Perugia, 2013: sandy bank and reef, type locality, NW coast of Malo Island, Vanuatu; **K, M.** 3.75 x 1.22 mm; **L.** protoconch 0.37 x 0.27 mm, reef. **N.** *Synthopsis praeacuta* Cecalupo & Perugia, 2012: 2.47 x 0.70 mm, sandy bank and reef; type locality, Panglao Is. Philippines. **O.** *Synthopsis tongoensis* Cecalupo & Perugia, 2016: 1.82 x 0.83 mm, sandy bank; type locality, Cebu, Moalboal, Tongo Point, Philippines. **P.** *Synthopsis turgida* Cecalupo & Perugia, 2012: 1.98 x 0.89 mm, sandy bank; type locality, Panglao Is. Philippines. **Q.** *Tubercliopsis minor* Cecalupo & Perugia, 2012: 2.08 x 0.58 mm, reef; type locality, Mactan Is., Philippines. **R-S.** *Tubercliopsis miranda* Cecalupo & Perugia, 2012: **R.** 3.60 x 0.88 mm, **S.** 4.30 x 0.95 mm, sandy bank, and reef; type locality, Pamilacan Is., Philippines.

Fig. 5. A-E. *Seila mactanensis* Cecalupo & Perugia, 2012: **A, C.** 3,65 x 1,13 mm; **D., E.** 3,23 x 1,10 mm, argine sabbioso e reef; località tipo, Is. Mactan, Punta Engaño, Filippine. **F.** *Seila silviae* Cecalupo & Perugia, 2012: 2,42 x 0,93 mm, argine sabbioso e reef; località tipo, Is. Panglao, Filippine. **G.** *Synthopsis albachiaerae* Cecalupo & Perugia, 2012: 2,46 x 0,82 mm, reef; località tipo, Is. Bohol, Filippine. **H.** *Synthopsis ampulla* Cecalupo & Perugia, 2012: 1,98 x 0,89 mm, argine sabbioso; località tipo, Is. Balicasag, Filippine. **I.** *Synthopsis bicincta* Cecalupo & Perugia, 2012: 1,87 x 0,70 mm, argine sabbioso e reef; località tipo, Is. Balicasag, Filippine. **J.** *Synthopsis impedita* Cecalupo & Perugia, 2012: 2,27 x 0,72 mm, argine sabbioso e reef; località tipo, Is. Panglao, Filippine. **K-M.** *Specula puillandrei* Cecalupo & Perugia, 2013: argine sabbioso e reef; località tipo, Vanuatu NW della costa dell'isola di Malo; **K, M.** 3,75 x 1,22 mm; **L.** protoconca 0,37 x 0,27 mm, reef. **N.** *Synthopsis praeacuta* Cecalupo & Perugia, 2012: 2,47 x 0,70 mm, argine sabbioso e reef; località tipo, Is. Panglao, Filippine. **O.** *Synthopsis tongoensis* Cecalupo & Perugia, 2016: 1,82 x 0,83 mm, argine sabbioso; località tipo, Cebu, Moalboal, Tongo Point, Filippine. **P.** *Synthopsis turgida* Cecalupo & Perugia, 2012: 1,98 x 0,89 mm, argine sabbioso; località tipo, Is. Panglao, Filippine. **Q.** *Tubercliopsis minor* Cecalupo & Perugia, 2012: 2,08 x 0,58 mm, reef; località tipo, Is. Mactan, Filippine. **R-S.** *Tubercliopsis miranda* Cecalupo & Perugia, 2012: **R.** 3,60 x 0,88 mm, **S.** 4,30 x 0,95 mm, argine sabbioso e reef; località tipo, Is. Pamilacan, Filippine.



Images Fig. 4.

- A.** *Joculator acuminatus* Cecalupo & Perugia, 2012: 1.63 x 0.70 mm, reef; type locality, Panglao Is., Philippines.
- B-D.** *Joculator arduini* Cecalupo & Perugia, 2012: **B.** 2.11 x 0.92 mm; **C.** 0.50 x 0.23 mm; **D.** 1.12 x 0.67 mm, sandy bank; type locality, Panglao Is., Philippines.
- E.** *Joculator lividus* Cecalupo & Perugia, 2012: 1.85 x 0.72 mm, reef; type locality, Panglao Is., Philippines.
- F, G.** *Joculator laguncula* (Cecalupo & Perugia, 2012): **F.** 2.12 x 0.70 mm; **G.** 2.53 x 0.76 mm, reef; type locality, Pamilacan Is., Philippines.
- 4. H.** *Marshallopsis* cf. *gattellii* Cecalupo & Perugia, 2012: 1.77 x 0.92 mm, reef; type locality, Bohol Is., Philippines.
- I.** *Prolixodens inopinata* (Cecalupo & Perugia, 2012): 2.60 x 0.93 mm, reef; type locality, Balicasag Is., Philippines.
- J.** *Prolixodens lutea* (Cecalupo & Perugia, 2012): 2.66 x 0.97 mm, reef and sandy bank; type locality, Pamilacan Is., Philippines.
- K-M.** *Prolixodens* cf. *mascarensis* (Jay & Drivas, 2002): **K, M.** 2.47 x 0.73 mm; **L.** protoconch 0.50 x 0.23 mm, sandy bank; type locality, Saint-Gilles-les-Bains, Reunion Island.
- N-P.** *Seila varenii* Cecalupo & Perugia, 2012: **N, P.** 6.26 x 1.50 mm; **O.** protoconch 0.57 x 0.40 mm, sandy bank; type locality, Mactan Is., Philippines.

Images Fig. 5.

- A-E.** *Seila mactanensis* Cecalupo & Perugia, 2012: **A, C.** 3.65 x 1.13 mm; **D., E.** 3.23 x 1.10 mm, sandy bank and reef; type locality, Mactan Is., Punta Engaño, Philippines.
- F.** *Seila silviae* Cecalupo & Perugia, 2012: 2.42 x 0.93 mm, sandy bank and reef; type locality, Panglao Is., Philippines.
- G.** *Synthopsis albachiarae* Cecalupo & Perugia, 2012: 2.46 x 0.82 mm, reef; type locality, Bohol Is., Philippines.
- H.** *Synthopsis ampulla* Cecalupo & Perugia, 2012: 1.98 x 0.89 mm, sandy bank; type locality, Balicasag Is., Philippines.
- I.** *Synthopsis bicincta* Cecalupo & Perugia, 2012: 1.87 x 0.70 mm, sandy bank and reef; type locality, Balicasag Is., Philippines.
- J.** *Synthopsis impedita* Cecalupo & Perugia, 2012: 2.27 x 0.72 mm, sandy bank and reef; type locality, Panglao Is., Philippines.
- K-M.** *Specula puillandrei* Cecalupo & Perugia, 2013: sandy bank and reef, type locality, NW coast of Malo Island, Vanuatu; **K, M.** 3.75 x 1.22 mm; **L.** protoconch 0.37 x 0.27 mm, reef.
- N.** *Synthopsis praeacuta* Cecalupo & Perugia, 2012: 2.47 x 0.70 mm, sandy bank and reef; type locality, Panglao Is., Philippines.
- O.** *Synthopsis tongoensis* Cecalupo & Perugia, 2016: 1.82 x 0.83 mm, sandy bank; type locality, Cebu, Moalboal, Tongo Point, Philippines.
- P.** *Synthopsis turgida* Cecalupo & Perugia, 2012: 1.98 x

0.89 mm, sandy bank; type locality, Panglao Is., Philippines.

- Q.** *Tubercliopsis minor* Cecalupo & Perugia, 2012: 2.08 x 0.58 mm, reef; type locality, Mactan Is., Philippines.
- R-S.** *Tubercliopsis miranda* Cecalupo & Perugia, 2012: **R.**, 3.60 x 0.88 mm, **S.**, 4.30 x 0.95 mm, sandy bank, and reef; type locality, Pamilacan Is., Philippines.

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Alzoniella cervarensis: un nuovo idrobiide freatobio del versante adriatico pugliese (Gastropoda: Caenogastropoda: Hydrobiidae)

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Riassunto

Ricerche sui molluschi freatobi effettuate in alcuni corsi d'acqua della Puglia e dei tributari adriatici della Campania, hanno portato alla scoperta di una nuova specie di Hydrobiidae, qui descritta come *Alzoniella cervarensis* n. sp. Si tratta del primo ritrovamento di un idrobiide appartenente al genere *Alzoniella* Giusti & Bodon, 1984, sul versante adriatico al sud della penisola italiana. *A. cervarensis* n. sp. è una specie localizzata nel bacino del Torrente Cervaro, nel Subappennino Dauno e nel Tavoliere delle Puglie. L'assegnazione generica della nuova specie è motivata dai caratteri della conchiglia e dell'apparato genitale maschile e femminile. Soprattutto quest'ultimo evidenzia una forte affinità con altre specie assegnate allo stesso genere, in particolare con *A. tanagrensis* Cianfanelli & Bodon, 2017, diffusa in Campania nel vicino sistema idrografico del Fiume Sele, tributario però del versante tirrenico. Vengono inoltre citate le altre specie di idrobiidi, raccolte nello stesso bacino del Torrente Cervaro, e *Bythinella* Moquin-Tandon, 1855, censita in un bacino limitrofo; alcune di queste entità sono segnalate per la prima volta in Puglia.

Parole chiave

Gastropoda, Hydrobiidae, Bythinellidae, tassonomia, Campania, Puglia.

Abstract

Research on phreatic hydrobiids carried out in the inland waters of northern Apulia and some Adriatic tributaries of Campania (southern Italy) have led to the discovery of a new species, here described as *Alzoniella cervarensis* n. sp. This is the first record of a mollusc belonging to the genus *Alzoniella* Giusti & Bodon, 1984, in the Adriatic side of southern Italian peninsula. *A. cervarensis* n. sp. lives in the Torrente Cervaro basin, from the Subappennino Dauno to the Tavoliere delle Puglie. The new taxon is assigned to the genus *Alzoniella* by virtue of its shell morphology and male and female genitalia; especially the anatomical characteristics show a strong affinity with other species assigned to this genus, mainly to *A. tanagrensis* Cianfanelli & Bodon, 2017, widespread in Campania in the nearby water system of the Sele River, although tributary of the Tyrrhenian side. The other hydrobiids collected in the Torrente Cervaro basin and *Bythinella* Moquin-Tandon, 1855, collected in a nearby basin, are listed; some of these data represent the first record for Apulia.

Key words

Gastropoda, Hydrobiidae, phreatic snails, taxonomy, Campania, Apulia.

Introduzione

Le specie di molluschi freatobi italiani, pur essendo presenti in quasi tutta la penisola, sono diffuse prevalentemente nei bacini idrografici tributari del nord Adriatico e in quelli del versante tirrenico (Bodon et al., 2005b). Tra queste, quelle freatobie assegnate al genere *Alzoniella* Giusti & Bodon, 1984, contano un discreto numero di specie (Bogi & Bartolini, 2014; Cianfanelli & Bodon, 2017). La prima specie ad essere stata descritta storicamente per il centro-sud Italia è *Alzoniella cornucopia* (De Stefani, 1880), proveniente dal Torrente Arbia, nel Senese (De Stefani, 1880; Manganelli et al., 1995). Questa entità è endemica della Toscana, essendo presente solo in pochi altri corsi d'acqua del senese e del grossetano, come il Torrente Massellone, il Torrente Crevole, il Torrente Farma e i torrenti Trasubbie e Trasubbino, tutti appartenenti al bacino del Fiume Ombrone (Manganelli et al., 1995; Benocci & Manganelli, 2016; dati personali inediti). Le altre specie sono state per lo più scoperte e descritte solo recentemente. Nelle falde alluvionali del bacino del

Fiume Magra, tra la Liguria e la Toscana, vivono tre taxa strettamente endemici: *Alzoniella lunensis* Bodon & Cianfanelli, 2002, *Alzoniella macrostoma* Bodon & Cianfanelli, 2002, e *Alzoniella microstoma* Bodon & Cianfanelli, 2002 (Bodon & Cianfanelli, 2002). Altre entità con la stessa ecologia sono state descritte per il sottobacino del Fiume Era, affluente del Fiume Arno, in Toscana: *Alzoniella manganellii* Bodon, Cianfanelli & Talenti, 1997, raccolta successivamente anche nel sottobacino del Fiume Sieve, e *Alzoniella* sp. 2 entità che, per l'impossibilità di reperire esemplari viventi, necessari per effettuare lo studio anatomico, non è ancora stata descritta formalmente (Bodon et al., 1997, 2005b). Inoltre, nell'Umbria e nelle Marche, vive *Alzoniella fabrianensis* (Pezzoli, 1969), specie assai rara e poco nota (Pezzoli, 1969, 1988; Manganelli et al., 1995). Questa specie è stata descritta per il bacino del Fiume Esino, unico tributario del versante adriatico dove è finora nota la presenza di questo genere, ed è inoltre presente nel bacino del Fiume Tevere (Bodon et al., 2005b).

Infine, recentemente, sono state scoperte per la prima

volta nelle acque freatiche del sud Italia altre due specie di *Alzoniella*: *A. tanagrensis* Cianfanelli & Bodon, 2017, e *A. calorensis* Cianfanelli & Bodon, 2017, entrambe endemiche del bacino del Fiume Sele, in Campania (Cianfanelli & Bodon, 2017). Nessuna specie di *Alzoniella* era invece conosciuta, sino ad ora, per i tributari del versante adriatico del sud Italia.

La Puglia è percorsa da pochi corsi d'acqua significativi, tutti localizzati nella parte settentrionale della regione, che originano dai Monti della Daunia, dato che il settore meridionale della regione è privo di rilievi montuosi ed è intensamente carsificato. Lungo il litorale adriatico, a nord del Promontorio del Gargano, sfocia il Fiume Fortore, mentre a sud del promontorio, presso Barletta, il Fiume Ofanto. Tra questi, a sud di Manfredonia, si trovano tre corsi d'acqua di un certo sviluppo: il Torrente Candelaro, il Torrente Cervaro e il Torrente Carapelle. Ricerche in questi corsi d'acqua, sebbene ancora incomplete, non hanno portato alla scoperta di molluschi freatici, fatta eccezione per il Torrente Cervaro.

Il Torrente Cervaro ha le sue sorgenti alle pendici del Monte Grossateglia, nel Subappennino Dauno; nella sua alta valle scorre in Campania, in provincia di Avellino, dopodiché attraversa il territorio pugliese, in provincia di Foggia. La maggior parte del torrente si snoda però nella pianura del Tavoliere delle Puglie attraversando, verso NE, gran parte del distretto della Capitanata, e sfociando nel Mar Adriatico presso Sciale Mizzillo, a sud di Manfredonia. Nella zona montuosa incide prevalentemente le unità calcareo-marnose (torbidi-tiche) del Miocene medio-inferiore, e sabbie e conglomerati del Pliocene, mentre il Tavoliere è caratterizzato, in prossimità del corso d'acqua, da alluvioni terrazzate Oloceniche. A partire dalla zona di Savignano Irpino, ancora in Campania, l'alveo si allarga e il corso d'acqua scorre sui depositi alluvionali ghiaiosi e sabbiosi, anche se in alcuni tratti di scarsa potenza, per l'affioramento di uno strato argilloso impermeabile.

Ricerche effettuate tra il 2015 e il 2018, condotte mediante esame delle posature alluvionali e dei sedimenti delle risorgive lungo il corso del Torrente Cervaro, hanno permesso di accertare la presenza di una nuova specie a conchiglia allungata e con l'apertura separata dall'ultimo anfratto. La separazione della bocca dall'ultimo anfratto è un carattere ricorrente nei taxa strettamente freatici, come in molte specie di *Alzoniella* (Cianfanelli & Bodon, 2017). Successive indagini, mediante ricerca nelle risorgive alimentate da acque freatiche di subalveo o nelle sorgenti alluvionali lungo le sponde del corso d'acqua, hanno portato infine al ritrovamento di alcuni esemplari viventi, permettendo di confermare l'habitat freatico e approfondire lo studio con i caratteri anatomici.

Materiali e metodi

Nel bacino del Torrente Cervaro sono stati campionati detriti alluvionali, sorgenti e diverse risorgive. Conchiglie ed esemplari completi di parti molli sono stati raccolti con l'ausilio di un retino di 0,5 mm di maglia, sca-

vando all'interno delle risorgive e filtrando l'acqua smuovendo il sedimento; altre conchiglie sono state raccolte setacciando le posature alluvionali depositate dalle piene lungo l'alveo o le sponde dei corsi d'acqua. Le fotografie delle conchiglie sono state realizzate con l'ausilio di un microscopio stereoscopico e con un software per l'acquisizione delle immagini. Le figure, ricavate da fotografie o da disegni scannerizzati, sono state assemblate tramite un software di grafica. Le dimensioni delle conchiglie (H: altezza totale, D: diametro massimo, h: altezza dell'apertura, d: diametro dell'apertura, come da fig. 1 A in Cianfanelli & Bodon, 2017) sono state misurate, con una lente micrometrica, al microscopio stereoscopico.

Per l'analisi statistica dei rapporti tra le dimensioni della conchiglia (rapporti che descrivono meglio le differenze nella forma tra le specie di *Alzoniella* dell'Italia Meridionale, H/D e H/h) sono stati usati i test Shapiro-Wilk, Levene, ANOVA e post-hoc Unequal N HSD, tramite il software StatSoft, Inc., versione 6.

Il materiale per l'esame anatomico, fissato in alcool 80 %, è stato studiato allo stereomicroscopio. Dopo la frammentazione della conchiglia, il corpo isolato è stato anatomizzato mediante pinzette da orologiaio a punta molto fine. Gli animali estratti dalla conchiglia e i dettagli anatomici sono stati, quindi, disegnati con l'ausilio di una camera lucida.

Le fotografie delle radule sono state realizzate dopo averle estratte dai bulbi boccali, lavate in acqua distillata e montate su supporti di alluminio, vaporizzati con uno strato d'oro, ed esaminati tramite un microscopio elettronico a scansione. Analogamente le fotografie della microscultura della protoconca e teleoconca e dell'opercolo sono state realizzate al SEM, montando le conchiglie sui supporti tramite mastice conduttivo.

Le indicazioni di raccolta sono riportate come segue: sito di prelievo e località, substrato campionato (se posature), altitudine, comune e sigla della provincia tra parentesi, coordinate UTM (ED 50), raccoglitori e date, numero di esemplari e/o di conchiglie tra parentesi. Il materiale riportato è distinto se conservato in alcool (maschi o femmine, anatomizzati) o a secco (conchiglie, "conch.", integre, di adulti se non specificato, rotte o frammenti, "framm. conch." o di giovani, "conch. juv."). Le stazioni sono elencate da monte verso valle. I nomi delle località sono stati tratti dalla cartografia ufficiale dell'Italia dell'IGM 1:25.000; le coordinate UTM sono state rilevate sul posto attraverso un GPS.

Il materiale studiato è depositato nelle seguenti collezioni: Museo di Storia Naturale del Sistema Museale d'Ateneo dell'Università di Firenze, sezione di Zoologia de "La Specola" (Via Romana 17, Firenze; MZUF e numero di collezione, inoltre i supporti, su cui sono montati i paratipi fotografati al microscopio elettronico a scansione, sono identificati dalla sigla "SEM" e un codice alfanumerico), M. Bodon (Via delle Eliche 100/8, Genova; MBC), S. Cianfanelli (Via Monferrato 3, Firenze; SCC), G. Nardi (Via Boschette 8/A, Gussago, Brescia; GNC), E. Talenti (Piazza Parri 4, Figline-Incisa Incisa, Firenze; ETC).

Acronimi utilizzati nella figura relativa alle parti anatomiche: a = ano; ct = ctenidio; dp = dotto peniale; e = esofago; g = gonoporo; ga = ghiandola dell’albume; gc = ghiandola della capsula; gp = ghiandola prostatica; i = intestino; lpr = lobo peniale rifrangente; og = ovidotto gonadale; op = opercolo; or = ovidotto renale; os = osfradio; p = pene; pf = pallottole fecali; pm = plica muscolare; r = retto; rd = ricettacolo distale (primo ricettacolo); rp = ricettacolo prossimale (secondo ricettacolo); s = stomaco; ss = sacco dello stilo; t = tentacolo; vd = vaso deferente.

Sistematica

Famiglia Hydrobiidae Troschel, 1857
Genere *Alzoniella* Giusti & Bodon, 1984

Alzoniella cervarensis n. sp.

Diagnosi

Conchiglia molto piccola, cilindro-conica, con spira breve e ultimo giro allungato; apertura non molto ampia, distaccata dall’ultimo giro; peristoma riflesso, ispessito sul margine columellare ma non sinuoso sul margine esterno. Superficie della protoconca con microscultura a forti malleazioni. Apparato genitale maschile con pene munito di un solo lobo rifrangente, ampio, rettangolare. Apparato genitale femminile con due ricettacoli del seme, privo di borsa copulatrice. Radula con dente centrale munito di due cuspidi basali per parte.

Conchiglia (Figg. 1, 2 A-D)

Molto piccola, cilindro-conica, con spira breve e apice ottuso, cerea e trasparente se fresca, formata da 3½ - 4½ giri convessi, a rapida crescita; ultimo giro allungato, ben sviluppato in altezza, pari a ca. 4/5 dell’altezza della conchiglia, con la porzione terminale discendente e distaccata dalla parete dell’ultimo giro. Suture mediamente profonde. Apertura non molto ampia, ovale, appena prosoclina; peristoma completamente separato dall’ultimo giro, continuo, riflesso, ispessito sul margine columellare ma non sinuoso superior-

mente, in corrispondenza del margine esterno. Superficie della protoconca con microscultura a forti malleazioni; superficie della teleoconca più finemente malleata e con deboli strie spirali nei primi giri, quindi granulosa negli ultimi giri, provvista di irregolari strie di accrescimento.

Dimensioni (Tab. 1)

Altezza della conchiglia 1,21-1,72 mm; diametro della conchiglia 0,67-0,86 mm; altezza (diametro maggiore) dell’apertura 0,48-0,66 mm; diametro (diametro minore) dell’apertura 0,39-0,51 mm.

Opercolo (Figg. 2 E, 3 G)

Corneo, ovale, paucispirale, di colore arancio, piuttosto ispessito sia al centro ma anche in prossimità del bordo; all’interno nella porzione inferiore è presente un evidente nucleo sporgente, ma privo di strutture opercolari.

Corpo (Fig. 3 A)

Totalmente depigmentato; tentacoli privi di macchie oculari.

Apparato genitale maschile (Fig. 3 A-E)

Testicolo situato presso l’apice del sacco viscerale; vaso efferente (spermidotto) convoluto; ghiandola prostatica sporgente nella cavità palleale; vaso deferente sottile, prende origine dalla parte anteriore della ghiandola prostatica e, dopo un breve tratto, attraversa la parete del corpo per proseguire nel pene. Pene collocato all’interno della cavità palleale, voluminoso, subcilindrico, un poco allungato e ripiegato su sé stesso, con la base larga e un po’ corrugata e un tratto apicale breve e appuntito. Un lobo laterale, di forma rettangolare, rifrangente, è presente sulla parte subapicale del pene, sul fianco sinistro; all’altezza di esso, ventralmente, è visibile una plica muscolare, poco sporgente. La porzione del deferente (dotto peniale) interna al pene è leggermente sinuosa presso la base, quindi decorre rettilinea e più vicina al lato destro del pene.

Specie	Località	H	D	h	d	N
<i>Alzoniella tanagrensis</i>	Stazioni bacino F. Sele	1,64 ± 0,22 (1,19-2,11)	0,70 ± 0,08 (0,52-0,87)	0,54 ± 0,05 (0,43-0,66)	0,43 ± 0,05 (0,33-0,52)	95
<i>Alzoniella calorensis</i>	Stazioni F. Calore	1,61 ± 0,22 (1,27-2,05)	0,87 ± 0,12 (0,66-1,13)	0,62 ± 0,07 (0,50-0,76)	0,50 ± 0,05 (0,43-0,60)	19
<i>Alzoniella cervarensis</i> n. sp.	Stazioni T. Cervaro	1,41 ± 0,17 (1,21-1,72)	0,76 ± 0,07 (0,67-0,86)	0,59 ± 0,06 (0,48-0,66)	0,46 ± 0,04 (0,39-0,51)	11

Tab. 1. Dimensioni delle conchiglie (in mm) delle popolazioni di *Alzoniella tanagrensis* Cianfanelli & Bodon, 2017, *Alzoniella calorensis* Cianfanelli & Bodon, 2017, del bacino del Sele (vedi Cianfanelli & Bodon, 2017) e *Alzoniella cervarensis* n. sp. del bacino del Cervaro. H: altezza della conchiglia; D: diametro della conchiglia; h: altezza (diametro maggiore) dell’apertura; d: diametro (diametro minore) dell’apertura; N: numero di conchiglie misurate. Media ± deviazione standard e range (tra parentesi).

Table 1. Shell sizes (in mm) of some populations of *Alzoniella tanagrensis* Cianfanelli & Bodon, 2017, *Alzoniella calorensis* Cianfanelli & Bodon, 2017, from Sele basin (see Cianfanelli & Bodon, 2017) and *Alzoniella cervarensis* n. sp. from Cervaro basin. H: shell height; D: shell diameter; h: mouth height (major diameter); d: mouth diameter (minor diameter); N: number of shells. Mean ± standard deviation; min and max value in parenthesis.

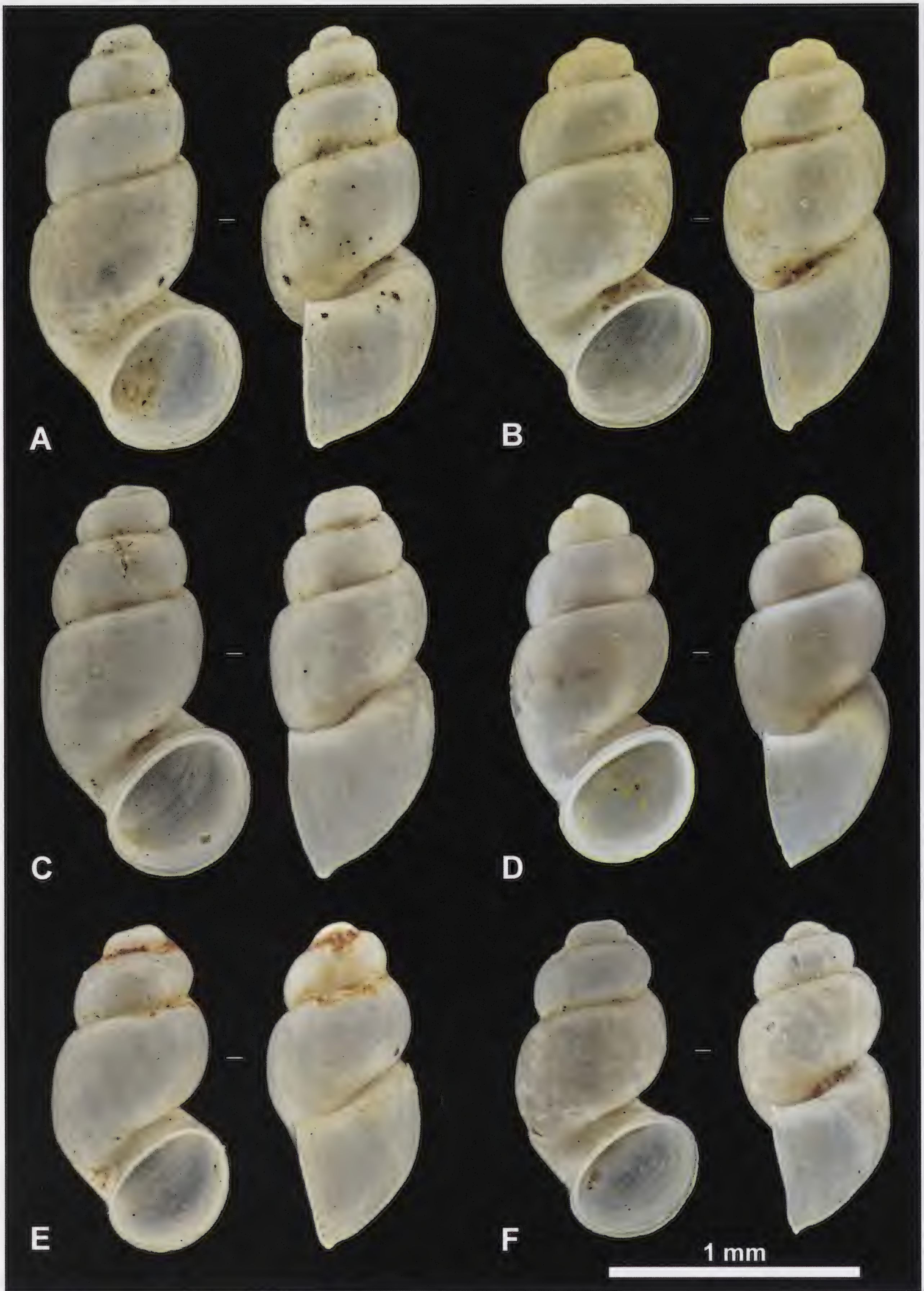


Fig. 1. Conchiglie di *Alzoniella cervarensis* n. sp., paratipi (A, B, D-F) e olotipo (C). A, C, E, F: località tipica, Torrente Cervaro, 1,0 km a NNW dall'ip-podromo di Castelluccio dei Sauri, (Castelluccio dei Sauri, FG), stazione n. 12 (A, E, F: MZUF GC/55126; C: MZUF GC/54798); B: stazione n. 8 (MZUF GC/54376); D: stazione n. 10 (MZUF GC/54345).

Fig. 1. Shells of *Alzoniella cervarensis* n. sp., paratypes (A, B, D-F) and holotype (C). A, C, E, F: type locality, Cervaro Stream, 1.0 km NNW from the racecourse of Castelluccio dei Sauri, (Castelluccio dei Sauri, FG), site n. 12 (A, E, F: MZUF GC/55126; C: MZUF GC/54798); B: site n. 8 (MZUF GC/54376); D: site n. 10 (MZUF GC/54345).

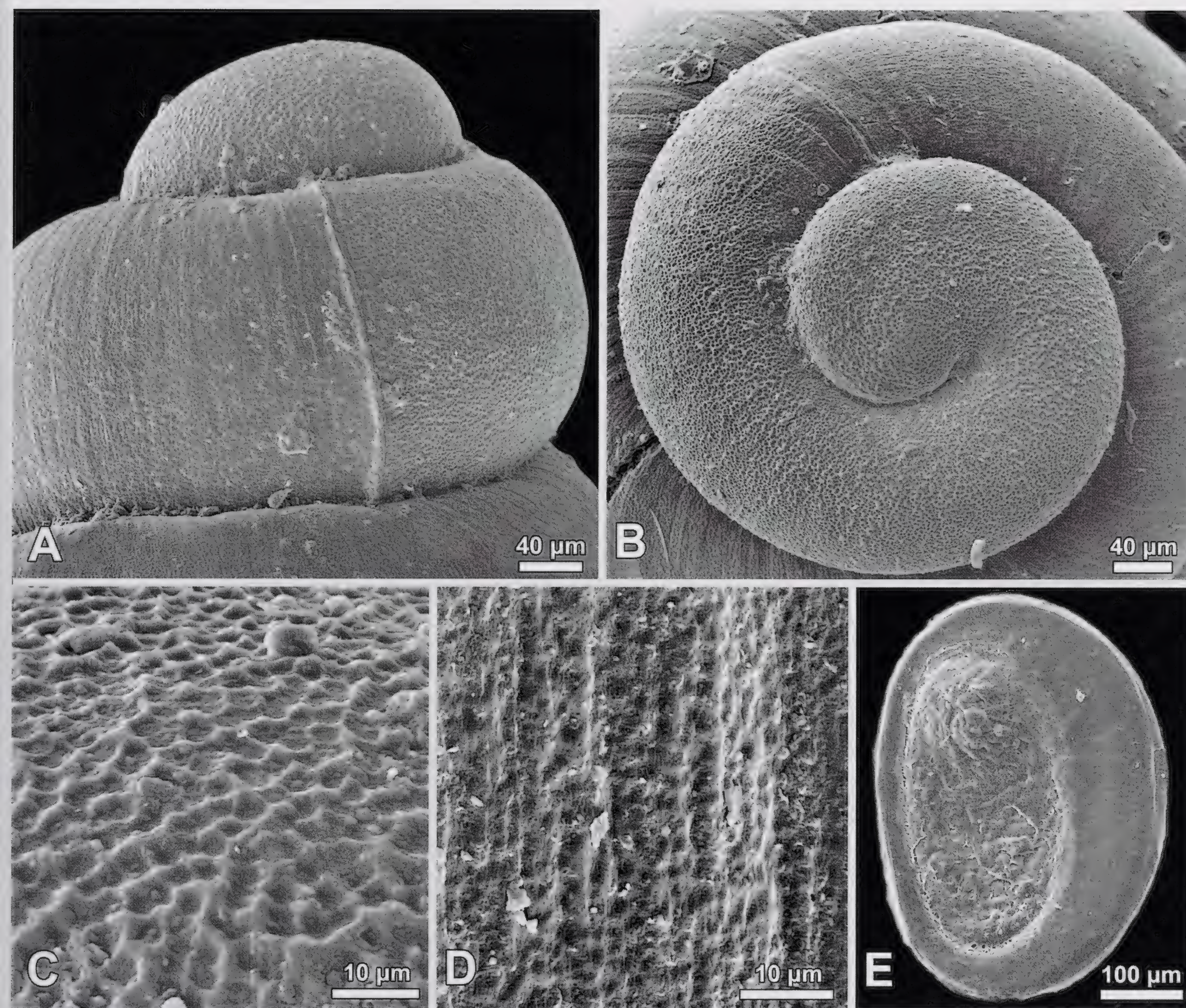


Fig. 2. Protoconca, teleoconca e opercolo di *Alzoniella cervarensis* n. sp. **A:** protoconca e inizio della teleoconca vista di profilo; **B:** protoconca e primi giri visti dall'alto; **C:** ingrandimento della protoconca; **D:** ingrandimento della teleoconca in prossimità dell'apertura; **E:** opercolo, visto dal lato interno. Conchiglie e opercolo raccolti nella stazione n. 13 (**A-C**, supporto SEM MZUF/263) e nella stazione n. 5 (**D, E**, supporto SEM MZUF/263).

Fig. 2. Protoconch, teleoconch and operculum of *Alzoniella cervarensis* n. sp. **A:** protoconch and first whorls of teleoconch in lateral view; **B:** protoconch and first whorls seen from above; **C:** magnification of protoconch; **D:** magnification of teleoconch near the aperture; **E:** operculum, seen from inner side. Shells and operculum collected in the site n. 13 (**A-C**, SEM stub MZUF/263) and in the site n. 5 (**D, E**, SEM stub MZUF/263).

Apparato genitale femminile (Fig. 3 F)

Ovario situato presso l'apice del sacco viscerale, seguito da un breve ovidotto gonadale. Ovidotto renale ingrossato, ripiegato a breve ansa ("loop") dopo l'inserzione del canale gono-pericardico, provvisto solo di due ricettacoli del seme (assente la borsa copulatrice). Ricettacolo prossimale (RS2) piuttosto piccolo, tondeggiante, brevemente peduncolato e situato appena dopo il termine del "loop"; ricettacolo distale (RS1) piccolo, situato al termine dell'ovidotto renale. Ovidotto palleale formato dalla ghiandola dell'albume e dalla ghiandola della capsula; quest'ultima, ben sporgente nella cavità palleale e ventralmente percorsa dal canale spermatico, si apre con un piccolo gonoporo situato in posizione molto arretrata rispetto al bordo palleale.

Radula (Fig. 4)

Teniglossa, formata da molte file di sette denti, ciascuna con formula:

$$C = 5-6 + 1 + 5-6 / 2 + 2; L = 5-6 + 1 + 5-6; M1 = 19-20, M2 = 11 \text{ ca.}$$

Dente centrale trapezoidale, con lunghe ali laterali e una proiezione basale a forma di cuneo. Margine anteriore a V, con bordo munito di 11-13 lunghi dentelli, il centrale un poco più sviluppato dei laterali. Dove le ali laterali si dipartono dal corpo del dente sono presenti due robuste cuspidi basali per parte, la prima più grande della seconda. Denti laterali a forma di rastrello, con apice munito di 11-13 lunghi dentelli, il centrale un poco più sviluppato dei laterali. Denti marginali interni a forma di rastrello, con ala laterale allungata e apice munito di 19-20 lunghi dentelli sul margine anteriore. Denti marginali esterni con ala laterale allungata, ma con apice a cucchiaio, provvisto di una serie di ca. 11 dentelli lungo il margine antero-posteriore.

Stomaco e intestino (Fig. 3 E, F)

Stomaco privo di cieco posteriore. Intestino munito di

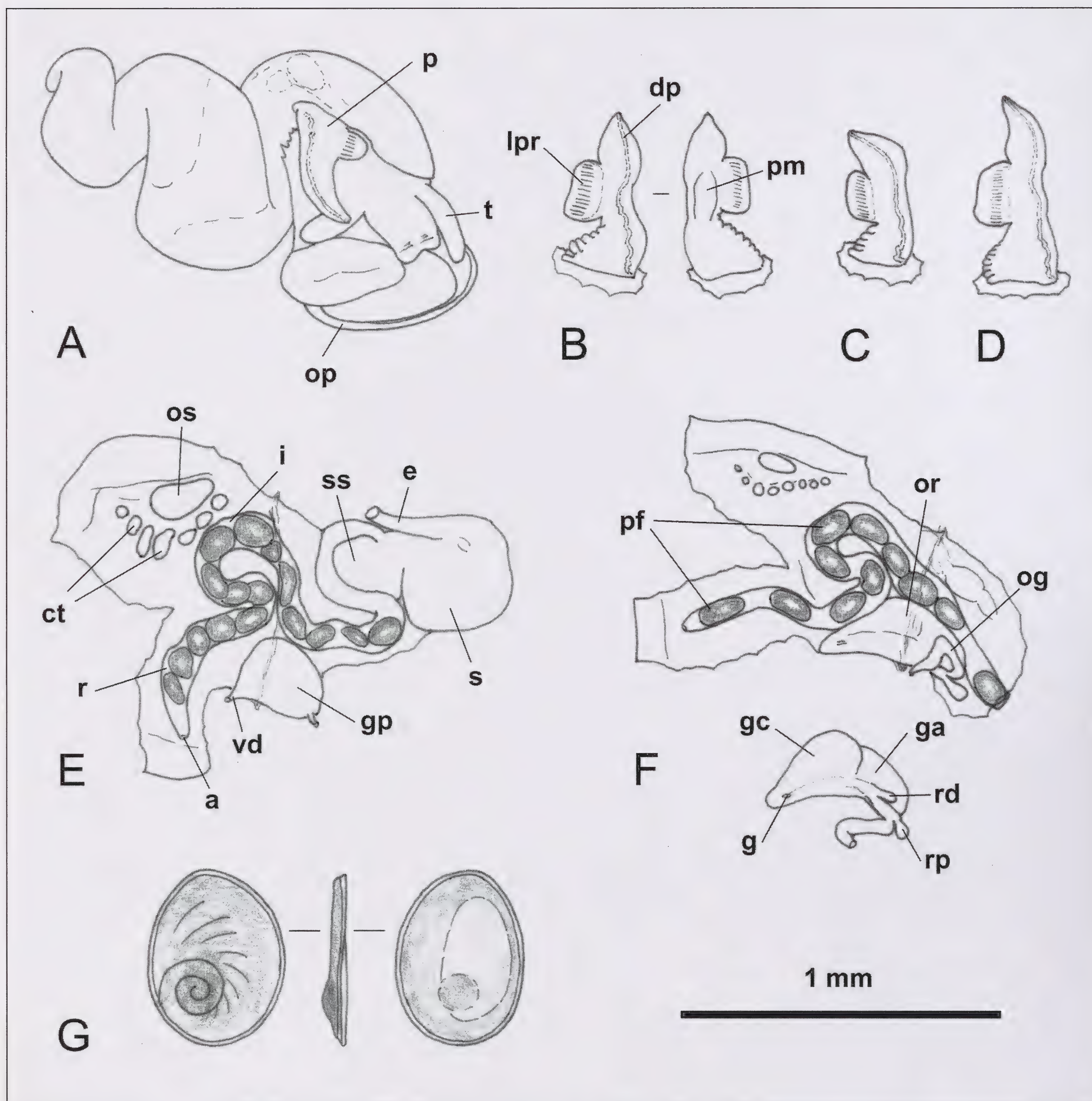


Fig. 3. Caratteri anatomici (A-F) e opercolo (G) di *Alzoniella cervarensis* n. sp. **A:** corpo di un maschio estratto dalla conchiglia e con la cavità palleale aperta; **B-D:** pene di tre maschi, il primo in visione dorsale (a sinistra) e ventrale (a destra); **E:** stomaco, intestino, ghiandola prostatica e organi palleali di un maschio; **F:** ovidotto renale e palleale, stomaco e organi palleali di una femmina, sotto l'ovidotto raffigurato con il loop disteso; **G:** opercolo visto dal lato esterno (a sinistra), di profilo (al centro) e dal lato interno (a destra). Esemplari raccolti nella stazione n. 5 (A, D, E, G, MZUF GC/54371), nella stazione n. 6 (B, C, MZUF GC/54525) e nella stazione n. 7 (F, MZUF GC/54528).

Fig. 3. Anatomical details (A-F) and operculum (G) of *Alzoniella cervarensis* n. sp. **A:** body of a male with pallial cavity open to show head and penis; **B-D:** penis of three males, the first from dorsal (left) and ventral (right) side; **E:** stomach, intestine, prostatic gland and pallial organs of a male; **F:** renal and pallial oviduct and pallial organs of a female, with the loop in natural position (upper) and the loop extended (lower); **G:** outer side (left), profile (centre) and inner side (right) of operculum. Specimens collected in the site n. 5 (A, D, E, G, MZUF GC/54371), in the site n. 6 (B, C, MZUF GC/54525) and in the site n. 7 (F, MZUF GC/54528).

due anse, la prima, a forma di U, affiancata al sacco dello stilo; la seconda, a forma di S ben appressata, sulla parete palleale. Porzione rettale piuttosto lunga, un poco sinuosa; ano situato in prossimità del bordo palleale.

Osfradio e ctenidio (Fig. 3 E, F)

Osfradio ovale o piriforme, poco allungato. Ctenidio

formato da 7-8 piccole lamelle. Ghiandola ipobranchiale non evidente.

Località tipica (Fig. 5 E)

Torrente Cervaro, 1,0 km NNO dall'Ippodromo di Castelluccio dei Sauri, posature in riva destra (Castelluccio dei Sauri, FG) (stazione n° 12).

Materiale tipico

Olotipo: esemplare raccolto nella località tipica, S. Cianfanelli & E. Talenti leg. 14/05/2017, conservato a secco nella collezione del Museo di Storia Naturale del Sistema Museale dell'Università di Firenze sez. Zoologia de "La Specola" (MZUF GC/54798, Fig. 1 C).

Paratipi

Tutto il restante materiale esaminato, proveniente dalle sorgenti alluvionali, risorgive o dalle posature nel bacino del Torrente Cervaro, di seguito elencato.

- 1. Risorgive nell'alveo del Torrente Cervaro, in riva sinistra, 2,7 km a ENE da Savignano di Puglia e 2 km a W dalla Stazione di Montaguto - Panni, 415 m s.l.m. (Savignano Irpino, AV), 33T WF1765, S. Cianfanelli & E. Talenti leg. 13/05/2016 (2 framm. conch., 1 conch. juv., MZUF GC/50487).
- 2. Sorgente sulla riva sinistra del Torrente Cervaro, scarpata costituita da alluvioni grossolane, 2,8 km a ENE da Savignano di Puglia e 1,9 km a W dalla Sta-

zione di Montaguto - Panni (Fig. 5 A), 415 m s.l.m. (Savignano Irpino, AV), 33T WF1765, S. Cianfanelli & E. Talenti leg. 13/05/2016 (18 framm. conch., MZUF GC/50490; 1 framm. conch., 1 conch. juv., GNC; 1 framm. conch., 1 conch. juv., ETC).

- 3. Risorgive nell'alveo del Torrente Cervaro, in riva sinistra, 2,9 km a ENE da Savigliano di Puglia e 1,7 km a W dalla Stazione di Montaguto - Panni (Fig. 5 B), 415 m s.l.m. (Savignano Irpino, AV), 33T WF1865, S. Cianfanelli & E. Talenti leg. 06/05/2015 (1 framm. conch., MZUF GC/47278).
- 4. Torrente Cervaro, riva destra 1,5 km a N di Bovino, posature, 280 m s.l.m. (Bovino, FG), 33T WF2868, S. Cianfanelli & E. Talenti leg. 13/05/2016 (1 conch. juv., MZUF GC/53342).
- 5. Risorgive nell'alveo del Torrente Cervaro, in riva destra, loc. Ischia, 1,0 km a ENE dalla Stazione di Bovino, 245 m s.l.m. (Bovino, FG), 33T WF3170, S. Cianfanelli & E. Talenti leg. 15/05/2017 (1 maschio, 1 framm. conch., 1 conch. juv., MZUF GC/54371, supporto SEM MZUF/263; Fig. 2 D, E, Fig. 3 A, D, E, G).

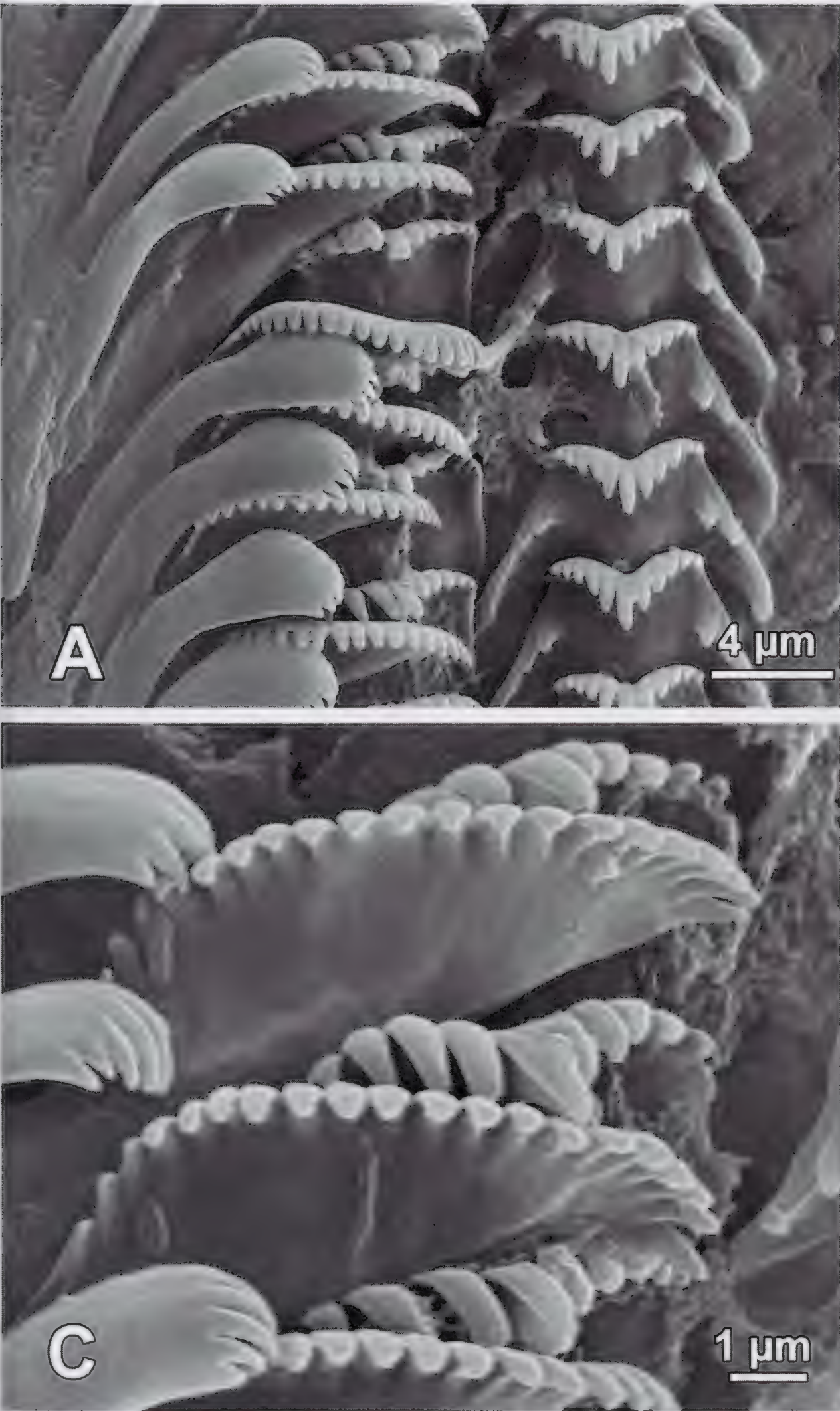


Fig. 4. Radula di *Alzoniella cervarensis* n. sp. **A**: visione d'insieme di una porzione centro-laterale della radula; **B**: ingrandimento di un dente centrale; **C**: ingrandimento di tre denti laterali (a destra), due marginali interni (al centro) e apice di tre denti marginali esterni (a sinistra); **D**: ingrandimento di quattro marginali esterni. Esemplare raccolto nella stazione n. 7 (MZUF GC/54528, supporto SEM MB/131).

Fig. 4. Radula of *Alzoniella cervarensis* n. sp. **A**: general view of the central-lateral portion; **B**: magnification of one central teeth; **C**: magnification of three lateral teeth (right), two inner marginal teeth (centre) and apex of three outer marginal teeth (left); **D**: magnification of four outer marginal teeth. Specimen collected in the in the site n. 7 (MZUF GC/54528, SEM stub MB/131).



Fig. 5. Ambienti di raccolta delle conchiglie e degli esemplari viventi di *Alzoniella cervarensis* n. sp., nel Torrente Cervaro e nelle sorgenti e risorgive sulle sponde o sul greto (indicate dalla freccia). **A:** torrente e sorgente nel tratto montano, nel Subappennino Dauno (stazione n. 2); **B:** risorgive nel tratto montano, nel Subappennino Dauno (stazione n. 3); **C:** torrente nel tratto iniziale di pianura, nel Tavoliere delle Puglie, in prossimità delle stazioni n. 6 e 7; **D:** sorgente nel tratto iniziale di pianura, nel Tavoliere delle Puglie (stazione n. 7); **E:** torrente nel tratto di pianura, nel Tavoliere delle Puglie (stazione n. 12); **F:** risorgiva nel tratto di pianura, nel Tavoliere delle Puglie (stazione n. 10).

Fig. 5. Sites of collecting of shells and living specimens of *Alzoniella cervarensis* n. sp., in the Cervaro Stream and in its springs and alluvial spring on its banks or riverbed (shown by arrow). **A:** stream and spring in the mountain course, in the Subappennino Dauno (site n. 2); **B:** alluvial springs in the mountain course, in the Subappennino Dauno (site n. 3); **C:** stream at the beginning of the plain course, in the Tavoliere delle Puglie, near the sites n. 6 and 7; **D:** spring at the beginning of the plain course, in the Tavoliere delle Puglie (site n. 7); **E:** stream in the plain course, in the Tavoliere delle Puglie (site n. 12); **F:** alluvial spring in the plain course, in the Tavoliere delle Puglie (site n. 10).

6. Risorgive nell'alveo del Torrente Cervaro, in riva sinistra, loc. Contrada Acquaviva, 15 m a valle della briglia e del ponte, 225 m s.l.m. (Bovino, FG), 33T WF3371, S. Cianfanelli & E. Talenti leg. 12/05/2018 (2 maschi, MZUF GC/54525, supporto SEM MB/119, 2 radule; **Fig. 3 B, C**).
7. Sorgente sulla riva sinistra del Torrente Cervaro, al contatto tra alluvioni e argille, loc. Contrada Acquaviva, 20 m a valle della briglia e del ponte (**Fig. 5 D**), 227 m s.l.m. (Bovino, FG), 33T WF3371, S. Cianfanel-

li & E. Talenti leg. 12/05/2018 (1 femmina, 3 conch. juv., MZUF GC/54528, supporto SEM MB/131, 1 radula; **Figg. 3 F, 4**).

8. Risorgive nell'alveo del Torrente Cervaro, in riva destra, 1,0 km a NW dall'Ippodromo di Castelluccio dei Sauri, 180 m s.l.m. (Castelluccio dei Sauri, FG), 33T WF3774, S. Cianfanelli & E. Talenti leg. 14/05/2017 (1 conch., MZUF GC/54376; **Fig. 1 B**).
9. Torrente Cervaro, in riva sinistra, 1,1 km a NNW dall'Ippodromo di Castelluccio dei Sauri, 175 m

s.l.m. (Castelluccio dei Sauri, FG), 33T WF3774, S. Cianfanelli & E. Talenti leg. 15/05/2017 (2 conch. juv., SCC).

10. Risorgive nell'alveo del Torrente Cervaro, in riva destra, 1,0 km a NNW, dall'Ippodromo di Castelluccio dei Sauri, 175 m s.l.m. (Castelluccio dei Sauri, FG), 33T WF3774, S. Cianfanelli & E. Talenti leg. 15/05/2017 (1 conch., MZUF GC/54345; **Fig. 1 D**; **Fig. 5 F**).
11. Risorgive nell'alveo del Torrente Cervaro, in riva sinistra, 1,0 km a NNW dall'Ippodromo di Castelluccio dei Sauri, 175 m s.l.m. (Castelluccio dei Sauri, FG), 33T WF3774, S. Cianfanelli & E. Talenti leg. 15/05/2017 (1 conch. juv., MZUF GC/52803).
12. Torrente Cervaro, in riva destra, 1,0 km a NNW dall'Ippodromo di Castelluccio dei Sauri, posature, 175 m s.l.m. (Castelluccio dei Sauri, FG), 33T WF3774, S. Cianfanelli & E. Talenti leg. 14/05/2017 (3 conch., 1 conch. juv., MZUF GC/55126; **Fig. 1 A, C, E, F**; **Fig. 5 E**).
13. Torrente Cervaro, in riva destra, a valle della briglia di Ponte Cervaro, posature, 105 m s.l.m. (Foggia, FG), 33T WF4678, S. Cianfanelli & E. Talenti leg. 12/05/2017 (3 conch. juv., MZUF GC/54697, supporto SEM MZUF/263; **Fig. 2 A-C**; 1 conch., MBC).

Origine del nome

La nuova specie prende il nome dal Torrente Cervaro, dove è stata scoperta.

Habitat

Gli esemplari viventi di *A. cervarensis* n. sp. sono stati raccolti solo nell'ambiente interstiziale delle risorgive o delle sorgenti alluvionali che sgorgano lungo il greto o le sponde del Torrente Cervaro.

Distribuzione geografica

La specie è stata raccolta esclusivamente nel bacino del Torrente Cervaro, in Campania e Puglia, dal tratto montano del Subappennino Dauno a quello pianeggiante del Tavoliere delle Puglie.

Inquadramento tassonomico

L'analisi degli apparati genitali di *Alzoniella cervarensis* n. sp., ha rivelato una concordanza con le specie del genere *Alzoniella* Giusti & Bodon, 1984, anche se, rispetto ad *A. finalina* Giusti & Bodon, 1984, la specie tipo, le femmine sono prive di borsa copulatrice (Giusti & Bodon, 1984). Data la variabilità nella forma e dimensione della borsa copulatrice nelle specie di questo genere (Giusti & Bodon, 1984), e dato che le specie italiane prive di questa struttura, come *A. ligustica* (Giusti & Bodon, 1981) e *A. parvula* (Giusti & Bodon, 1981), in precedenza assegnate ad *Avenionia* Nicolas, 1882, sono state recentemente collocate nel genere *Alzoniella*, anche sulla base di evidenze genetiche (Giusti & Bodon, 1981; Cian-

fanelli & Bodon, 2017), si ritiene opportuno inquadrare la nuova specie in questo genere.

Il genere *Alzoniella* è quindi caratterizzato da una conchiglia allungata, dalla presenza di uno o più lobi ghiandolari sul pene nei maschi e dalla presenza di due ricettacoli del seme nell'apparato genitale delle femmine (Giusti & Bodon, 1981; Boeters, 1983; Bodon, 1988; Boeters, 1988; Boeters & Rolán, 1988; Rolán, 1991; Boeters, 1998, 1999, 2000; Beran & Horsác, 2001; Boeters, 2001; Glöer, 2002; Arconada et al., 2007, 2008; Rolán & Boeters, 2015; Cianfanelli & Bodon, 2017). L'areale di distribuzione comprende diverse nazioni del centro-sud Europa, dove sono presenti 34 taxa terminali secondo Bank & Neubert (2017), senza contare le specie assegnate a *Navarriella* Boeters, 2000, taxon probabilmente da elevare a livello di genere anziché attribuirlo a livello sottogenerico. Comunque altre entità inedite sono presenti in Italia, da nord a sud della penisola, ad eccezione del settore nord-orientale (**Tab. 2**).

Le specie diffuse nelle altre nazioni europee possiedono una conchiglia con peristoma aderente all'ultimo anfratto, ad eccezione di *Alzoniella murita* Boeters, 2003, specie assegnata a questo genere anche se non nota nei caratteri anatomici, che presenta il peristoma appena separato dall'ultimo anfratto (non nettamente distanziato come in *A. cervarensis* n. sp.) (Boeters, 2003; Arconada et al., 2007, 2008; Álvarez Halcón et al., 2012).

Le specie italiane attualmente note sono 24; tra queste 11 sono specie prevalentemente freatobie, che possiedono il peristoma separato dall'ultimo anfratto (Bogi & Bartolini, 2014; **Tab. 2**). *Alzoniella* sp. 6, entità inedita endemica del sottobacino del Torrente Borbera, in Piemonte, presenta una conchiglia simile ad *A. cervarensis* n. sp., ma le femmine possiedono la borsa copulatrice (dati personali inediti). Quelle presenti nel bacino del Fiume Magra, tra la Liguria orientale e la Toscana settentrionale, sono ben diverse da *A. cervarensis* n. sp. per l'aspetto della spira, allungata o molto allungata, e per i lobi peniali più numerosi (Bodon & Cianfanelli, 2002). Tra le altre specie presenti in Toscana, *Alzoniella manganellii* Bodon, Cianfanelli & Talenti, 1997, è caratterizzata da una conchiglia con costolatura assiale evidente; *Alzoniella* sp. 2, è distinta per la conchiglia più allungata con i giri poco convessi; *Alzoniella cornucopia* (De Stefani, 1880), si differenzia per la conchiglia più conica, con i giri più convessi (Manganelli et al., 1995; Bodon et al., 1997). *A. fabrianensis*, specie poco nota, segnalata per le Marche e l'Umbria, presenta una conchiglia più allungata, conica, con il peristoma appena distaccato dall'ultimo anfratto (Pezzoli, 1969; Giusti & Pezzoli, 1980; Manganelli et al., 1995). Le specie più prossime geograficamente, presenti nel bacino del Fiume Sele, in Campania, *A. tanagrensis* Cianfanelli & Bodon, 2017 e *A. calorensis* Cianfanelli & Bodon, 2017, presentano una conchiglia di forma differente; sono entrambe decisamente coniche e con peristoma più distaccato dall'ultimo anfratto, ma la spira è più allungata in *A. tanagrensis* e più breve e raccorciata in *A. calorensis* (Cianfanelli & Bodon, 2017) (**Fig. 6**). Comunque i caratteri anatomici della nuova specie sono molto prossimi a quelli di *A. tanagrensis* (*A. caloren-*

Specie	Peristoma separato dall'ultimo anfratto	N° lobi peniali	Borsa copulatrice	Habitat	Distribuzione	Bibliografia
<i>Alzoniella bergomensis</i> Pezzoli, 2010	-	-	+	AF, AP	Lombardia	Pezzoli, 2010; Bodon et al., 2005b (<i>Alzoniella</i> sp. 3)
<i>Alzoniella braccoensis</i> Bodon & Cianfanelli, 2004	-	2	+	AF	Liguria	Bodon & Cianfanelli, 2004; Bodon et al., 2005b (<i>Alzoniella</i> sp. 1)
<i>Alzoniella calorenensis</i> Cianfanelli & Bodon, 2017	+	?	?	AP	Campania	Cianfanelli & Bodon, 2017
<i>Alzoniella cervarensis</i> n. sp.	+	1	-	AP	Campania, Puglia	Presente articolo
<i>Alzoniella cornucopia</i> (De Stefani, 1880)	+	1	+	AP	Toscana	Manganelli et al., 1995; Bodon et al., 2005b
<i>Alzoniella delmastroi</i> Bodon & Cianfanelli, 2004	-	2	+	AF	Piemonte	Bodon & Cianfanelli, 2004
<i>Alzoniella fabrianensis</i> (Pezzoli, 1969)	+	1	+	AF, AP	Umbria, Marche	Pezzoli, 1969; Manganelli et al., 1995; Bodon et al., 2005b
<i>Alzoniella feneriensis</i> Giusti & Bodon, 1984	-	2	+	AC, AP	Piemonte	Giusti & Bodon, 1984; Bodon et al., 2005b
<i>Alzoniella finalina</i> Giusti & Bodon, 1984	-	2	+	AC, AF	Piemonte, Emilia-Romagna, Liguria	Giusti & Bodon, 1984; Bodon et al., 2005b
<i>Alzoniella ligustica</i> (Giusti & Bodon, 1981)	-	1-2	-	AC, AF	Piemonte, Emilia-Romagna, Liguria, Toscana	Giusti & Bodon, 1981; Pezzoli, 1988a, 1988b; Pezzoli, 1996b; Bodon et al., 2005b
<i>Alzoniella lunensis</i> Bodon & Cianfanelli, 2002	+	4	-	AP	Liguria, Toscana	Bodon & Cianfanelli, 2002; Bodon et al., 2005b
<i>Alzoniella macrostoma</i> Bodon & Cianfanelli, 2002	+	3-4	+	AP	Liguria, Toscana	Bodon & Cianfanelli, 2002; Bodon et al., 2005b
<i>Alzoniella manganellii</i> Bodon, Cianfanelli & Talenti, 1997	+	1	+	AP	Toscana	Bodon et al., 1997; Bodon et al., 2005b
<i>Alzoniella microstoma</i> Bodon & Cianfanelli, 2002	+	3-4	+	AP	Liguria, Toscana	Bodon & Cianfanelli, 2002; Bodon et al., 2005b
<i>Alzoniella parvula</i> (Giusti & Bodon, 1981)	-	1	-	AC, AF	Liguria	Giusti & Bodon, 1981; Pezzoli, 1988a; Pezzoli, 1996a, 1996b; Bodon et al., 2005b
<i>Alzoniella sigestra</i> Giusti & Bodon, 1984	-	1	+	AC, AF	Liguria	Giusti & Bodon, 1984; Bodon et al., 2005b
<i>Alzoniella tanagensis</i> Cianfanelli & Bodon, 2017	+	1	-	AP	Campania, Basilicata	Cianfanelli & Bodon, 2017
<i>Alzoniella</i> sp. 1	-	1-2	-	AC, AF, AP	Piemonte, Liguria	Pezzoli, 1988a, 1996b; Bodon et al., 2005b (<i>Avenionia</i> sp. 1)
<i>Alzoniella</i> sp. 2	+	2	?	AP	Toscana	Bodon et al., 1997; Bodon et al., 2005b
<i>Alzoniella</i> sp. 3	-	-	-	AF	Liguria	Pezzoli, 1988a, 1996b; Bodon et al., 2005b (<i>Avenionia</i> sp. 2)
<i>Alzoniella</i> sp. 4	-	3	-	AF	Emilia-Romagna, Liguria	Cianfanelli & Bodon, 2017
<i>Alzoniella</i> sp. 5	-	3	+	AP	Piemonte	Dato personale inedito
<i>Alzoniella</i> sp. 6	+	1	+	AP	Piemonte	Dato personale inedito
<i>Alzoniella</i> sp. 7	-	1	+	AC	Toscana	Dato personale inedito

Tab. 2. Elenco delle specie, attribuibili al genere *Alzoniella* Giusti & Bodon, 1981, presenti in Italia; alcuni caratteri diagnostici della conchiglia e dell’apparto riproduttore, habitat, distribuzione a livello regionale e principali citazioni bibliografiche. Caratteri: +: presente; -: assente. Habitat: AC: acquifero carsico; AF: acquifero fratturato; AP: acquifero permeabile per porosità.

Table 2. List of the Italian species now included in genus *Alzoniella* Giusti & Bodon, 1981; main diagnostic characters of the shell and reproductive tract, habitat, distribution at regional level and main references. Characters: +: present; -: not present. Habitat: AC: karstic aquifer; AF: fractured aquifer; AP: porous aquifer.

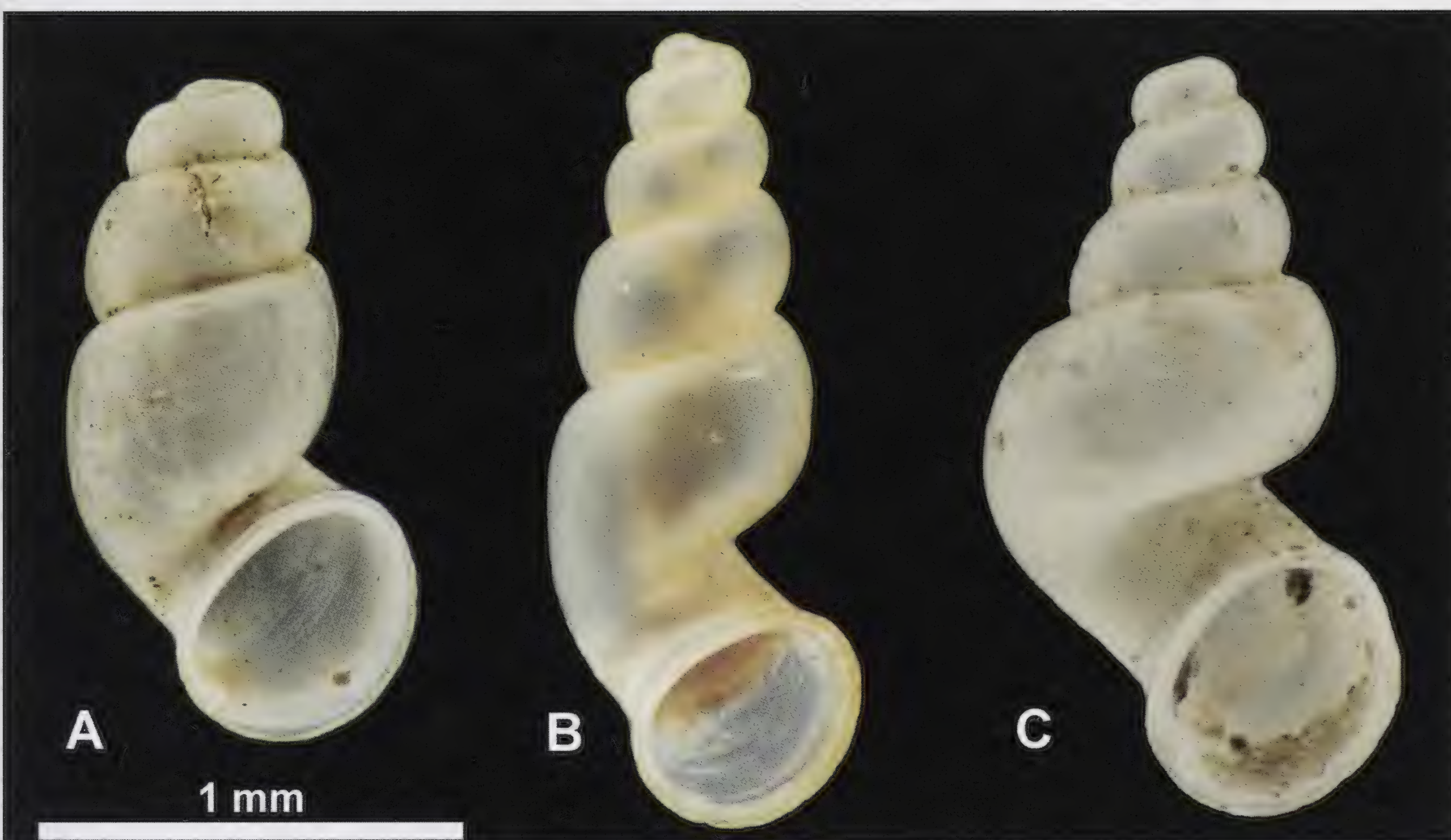


Fig. 6. Le tre specie di *Alzoniella* presenti nel sud Italia. **A:** *Alzoniella cervarensis* n. sp. (Olotipo MZUF GC/54798); **B:** *Alzoniella tanagrensis* Cianfanelli & Bodon, 2017 (Olotipo MZUF GC/45811); **C:** *Alzoniella calorensis* Cianfanelli & Bodon, 2017 (Olotipo MZUF GC/49011).

Fig. 6. The three *Alzoniella* species present in southern Italy. **A:** *Alzoniella cervarensis* n. sp. (Olotipo MZUF GC/54798); **B:** *Alzoniella tanagrensis* Cianfanelli & Bodon, 2017 (Olotipo MZUF GC/45811); **C:** *Alzoniella calorensis* Cianfanelli & Bodon, 2017 (Olotipo MZUF GC/49011).

sis non è nota nell'anatomia), sia per la mancanza della borsa copulatrice, sia per la presenza di un solo lobo peniale rifrangente, sia per l'opercolo inspessito, con nucleo sporgente sul lato interno. Tutto ciò sembra evidenziare una certa affinità tra la nuova specie e queste altre due specie del Sud Italia. Le lievi differenze riscontrate nell'anatomia di *A. cervarensis* n. sp., ovvero la presenza di uno ctenidio, il lobo peniale rettangolare, il secondo ricettacolo un poco più grande del primo (ctenidio assente, lobo peniale a forma di ventaglio, secondo ricettacolo subeguale al primo in *A. tanagrensis*), sono caratteri poco consistenti in considerazione dello scarso numero di individui e popolazioni esaminate.

Comunque i caratteri della conchiglia differenziano nettamente la nuova specie da *A. tanagrensis*, che presenta la spira molto più allungata, ma anche da *A. calorensis*, che presenta invece la spira breve, ma più conica e affilata (Figg. 1, 6; Cianfanelli & Bodon 2017, figg. 2, 8). Anche i parametri morfometrici relativi ai rapporti tra altezza e diametro della conchiglia (H/D) e tra altezza e diametro dell'apertura (H/h) delle tre specie mostrano differenze statisticamente significative (Figg. 7, 8, dove sono riportati i box-plot relativi alla distribuzione delle misure morfometriche nelle diverse popolazioni e i grafici relativi ai rispettivi valori). Per verificare il livello di significatività delle differenze nei valori dei parametri ricavati in base alle dimensioni della conchiglia, sono stati applicati alcuni test statistici ai diversi insiemi di popolazioni, suddivisi per specie e per bacini idrografici (bacino e sottobacini del Fiume Sele per *A. tanagrensis*, sottobacino del Fiume Calore per *A. calorensis*, bacino del T. Cervaro per *A. cervarensis* n. sp.). Previa verifi-

ca della distribuzione di tipo normale per ciascun insieme di dati tramite il test Shapiro-Wilk ($p > 0,05$) e della omogeneità delle varianze tramite il test Levene ($p > 0,05$), è stato applicato il test ANOVA a una via sia ai rapporti H/D che a quelli H/h. Per il rapporto H/D il test ANOVA mostra una differenza altamente significativa tra gruppi ($p < 0,01$); tramite il post-hoc test Unequal N HSD il livello di differenziazione tra *A. calorensis* e *A. cervarensis* non mostra differenze statisticamente significative ($p > 0,05$); invece *A. tanagrensis* mostra differenze altamente significative nei confronti delle altre due specie ($p < 0,01$). Anche per il rapporto H/h sulle tre specie mostra differenze altamente significative tramite il test ANOVA ($p < 0,01$) ma, in questo caso, tramite il post-hoc test Unequal N HSD il livello di differenziazione è statisticamente significativo ($p < 0,05$) per ciascuna coppia di specie.

Altri molluschi acquatici del bacino del Torrente Cervaro

Nella Tab. 3 sono riportati tutti i molluschi acquidulcicoli raccolti nel bacino del Torrente Cervaro e, in dettaglio, la distribuzione nelle stazioni dove è stata riscontrata la presenza di *Alzoniella cervarensis* n. sp. Mentre *A. cervarensis* n. sp. è un taxa freatobio, essendo confinato agli acquiferi alluvionali, *Arganiella pescei* Giusti & Pezoli, 1980, frequente nelle stesse stazioni, anch'essa specie esclusiva di acque sotterranee, presenta uno spettro ecologico più ampio, in quanto colonizza anche il condotto interno di sorgenti in acquiferi fratturati e carsici. *Islamia pusilla* (Piersanti, 1952) è frequente nelle posatu-

Taxa \ Stazioni	N° 01 R	N° 02 S	N° 03 R	N° 04 T	N° 05 R	N° 06 R	N° 07 T	N° 08 R	N° 09 T	N° 10 R	N° 11 R	N° 12 T	N° 13 T
<i>Potamopyrgus antipodarum</i> (Gray, 1843)	V	C	C		V			C	C	C	C	C	
<i>Pseudamnicola orsinii</i> (Küster, 1852)	V		C	C	C				C	V	C	C	C
<i>Belgrandia minuscula</i> (Paulucci, 1881)							V						
<i>Arganiella pescei</i> Giusti & Pezzoli, 1980				C	V		V	V	C	C		C	C
<i>Alzoniella cervarensis</i> n. sp.	C	C	C	C	V	V	V	C	C	C	C	C	C
<i>Islamia pusilla</i> (Piersanti, 1952)	V	C	V	C		C	V		C	V	C	C	C
<i>Galba</i> (<i>Galba</i>) <i>truncatula</i> (Müller, 1774)	V		C	C	C	C	C		C			C	C
<i>Radix labiata</i> (Rossmässler, 1835)													
<i>Physella</i> (<i>Acutiana</i>) <i>acuta</i> (Draparnaud, 1805)	V		C	C	C	C	C	C	C	C	C	C	C
<i>Planorbis</i> (<i>Planorbis</i>) <i>planorbis</i> (Linnaeus, 1758)												C	C
<i>Gyraulus</i> (<i>Torquis</i>) <i>laevis</i> (Alder, 1838)										C			
<i>Gyraulus</i> (<i>Armiger</i>) <i>crista</i> (Linnaeus, 1758)													C
<i>Hippeutis complanatus</i> (Linnaeus, 1758)													C
<i>Ancylus fluviatilis</i> Müller, 1774	C	C	C		C			C		C			
<i>Pisidium</i> (<i>Euglesa</i>) <i>casertanum</i> (Poli, 1791)				C				C		C	C		
<i>Pisidium</i> (<i>Euglesa</i>) <i>personatum</i> Malm, 1855				C								C	

Tab. 3. Elenco completo dei molluschi acquatici trovati nel bacino del Torrente Cervaro; viene riportata la distribuzione per le sole stazioni campionate dove è presente *Alzoniella cervarensis* n. sp. Stazioni: la numerazione delle stazioni corrisponde a quella dell’elenco nel testo. Ambiente: R: risorgive; S: sorgenti; T: torrente (posature); V: presenza di esemplari viventi; C: ritrovamento di sole conchiglie.

Table 3. Complete list of the aquatic molluscs collected in Cervaro Stream basin with the distribution of the other species for the localities where the new species was present. Number of sites are listed as in the text. Habitat: R: alluvial springs; S: springs along the banks; T: stream (debris collected). V: specimens live collected; C: empty shells only.

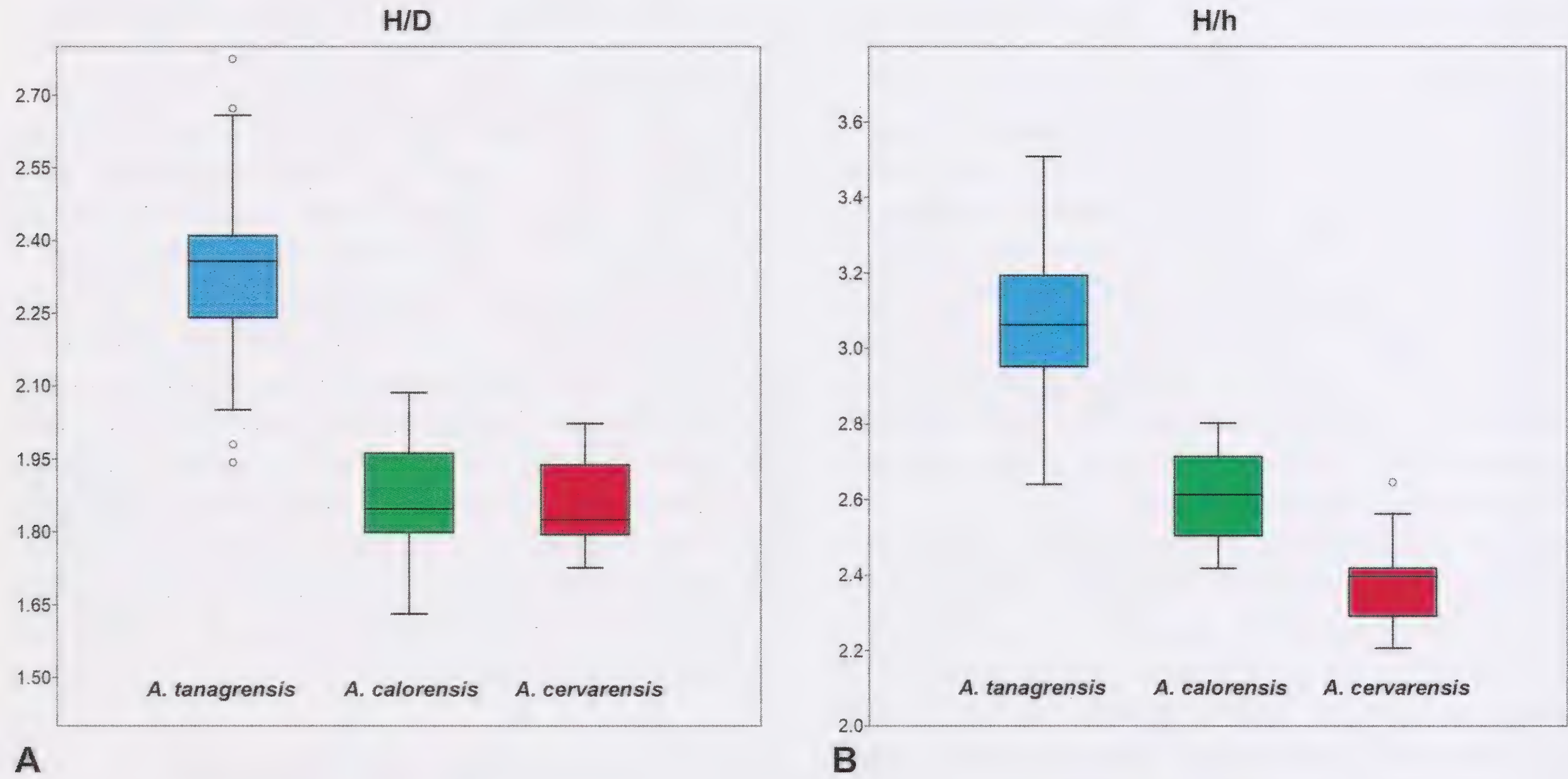


Fig. 7. Intervalli dei parametri statistici inerenti il rapporto fra altezza e diametro della conchiglia (H/D) (**A**) e il rapporto fra altezza della conchiglia e altezza dell’apertura (H/h) (**B**) nelle popolazioni di *Alzoniella tanagrensis* Cianfanelli & Bodon, 2017, *Alzoniella calorensis* Cianfanelli & Bodon, 2017, del bacino del Sele (vedi Cianfanelli & Bodon, 2017) e *Alzoniella cervarensis* n. sp. del bacino del Cervaro.

Fig. 7. Box-plots of the statistical parameter between shell height H / shell diameter D ratio (**A**), shell height H / aperture height h ratio (**B**) in the populations of *Alzoniella tanagrensis* Cianfanelli & Bodon, 2017, *Alzoniella calorensis* Cianfanelli & Bodon, 2017, from Sele basin (see Cianfanelli & Bodon, 2017), and *Alzoniella cervarensis* n. sp. from Cervaro basin.

re e nelle risorgive del bacino del Cervaro; questa specie può insediarsi anche in reticoli carsici ipogei, ma colonizza soprattutto acque sorgive. *Belgrandia minuscula* (Paulucci, 1881), infine, decisamente più rara nel bacino in esame, si insedia soprattutto nelle sorgenti.

Il ritrovamento di *Arganiella pescei* e di *Belgrandia minuscula* in provincia di Foggia costituisce la prima segnalazione di queste specie per la Puglia. *A. pescei* è presente nelle Marche, Umbria, Lazio, Abruzzo, Molise, Campania e nord della Puglia (Giusti & Pezzoli, 1981; Bodon

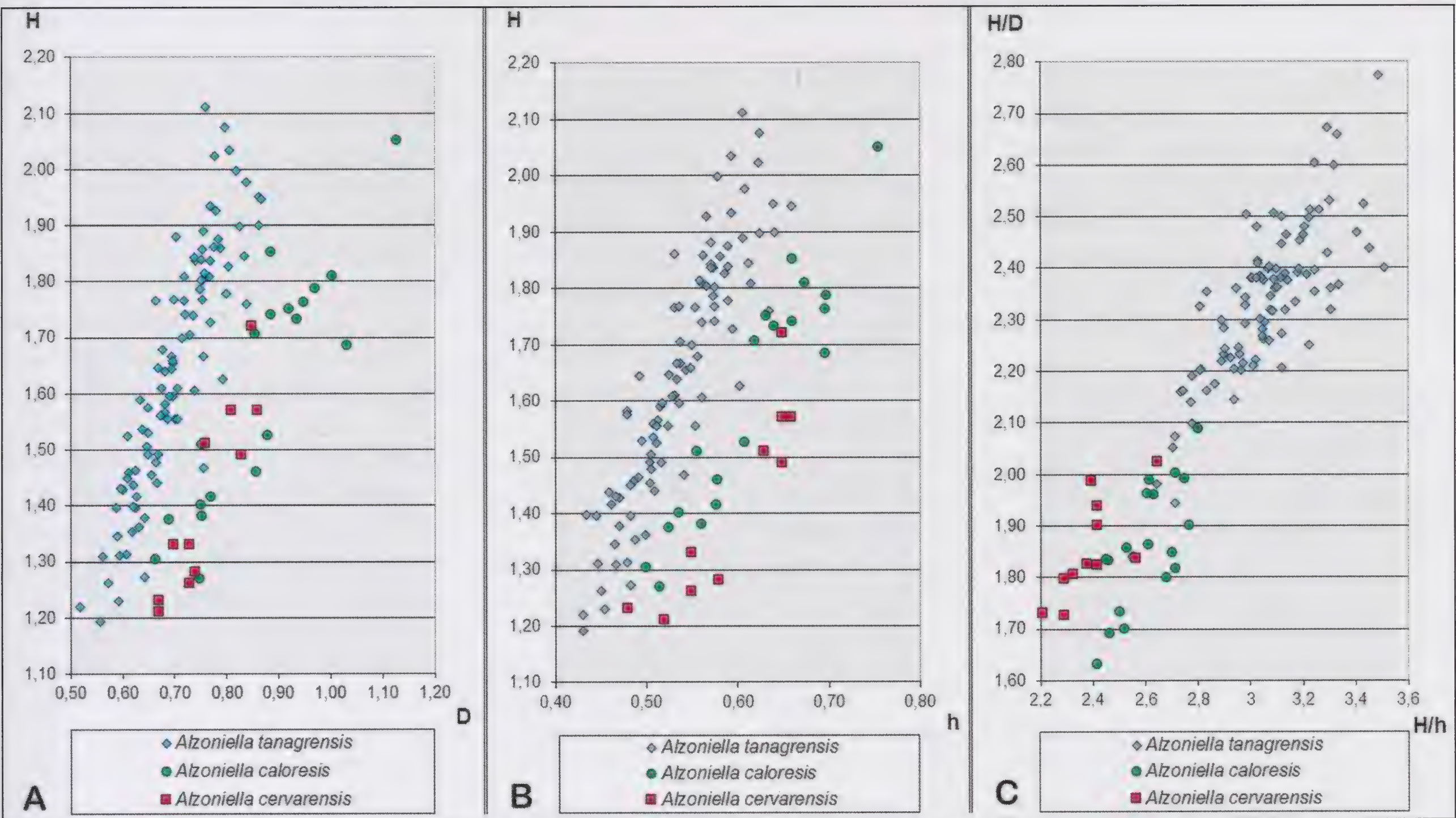


Fig. 8. Rapporto fra altezza (H, in mm) e diametro della conchiglia (D, in mm) (A), fra altezza della conchiglia (H, in mm) e altezza dell'apertura (h) (B) e fra i rapporti H/D e H/h (C) nelle popolazioni di *Alzoniella tanagensis* Cianfanelli & Bodon, 2017, *Alzoniella caloresis* Cianfanelli & Bodon, 2017, del bacino del Sele (vedi Cianfanelli & Bodon, 2017) e *Alzoniella cervarensis* n. sp. del bacino del Cervaro.

Fig. 8. Shell height H / shell diameter D ratio (A), shell height H / aperture height h ratio (B) and H/d / H/h ratio (C) in the populations of *Alzoniella tanagensis* Cianfanelli & Bodon, 2017, *Alzoniella caloresis* Cianfanelli & Bodon, 2017, from Sele basin (see Cianfanelli & Bodon, 2017), and *Alzoniella cervarensis* n. sp. from Cervaro basin. Dimensions in mm.

et al., 2001; Bodon et al., 2005b) (**Fig. 9 A**). *B. minuscula*, entità recentemente riesaminata, è diffusa nel basso Lazio, Molise, Campania, Puglia, Basilicata e nord della Calabria (Cianfanelli & Bodon, 2017) (**Fig. 9 B**). In Puglia è stata recentemente raccolta, oltre che nel bacino del Cervaro, anche in provincia di Taranto, in una sorgente costiera che sfocia nel Mar Piccolo (dati personali inediti). *Islamia pusilla* è già stata segnalata per la provincia di Foggia (Bodon et al., 2005b), ma queste segnalazioni sono da verificare (quindi non riportate in Bodon & Cianfanelli, 2012), in quanto riguardano sorgenti costiere, dove potrebbe essere presente la specie simile *Islamia cianensis* Bodon, Manganeli, Sparacio & Giusti, 1995, la cui presenza è stata accertata anche in Puglia, nel Salento (Bodon & Cianfanelli, 2012) e in una sorgente costiera che sfocia nel Mar Piccolo (dati personali inediti). Le altre specie acquatiche trovate nel bacino del Cervaro sono specie piuttosto banali e già segnalate per la Puglia, come *Pseudamnicola orsinii* (Küster, 1852) e *Potamopyrgus antipodarum* (Gray, 1843) (Paulucci, 1880; Forcart, 1965; Ferreri, 1995; Bodon et al., 2005a, 2005b). La prima, corrispondente a *Pseudamnicola conovula* (Frauenfeld, 1863) e riportata come *Pseudamnicola* sp. 2 in Delicado et al. (2015), è riconducibile a *P. orsinii* dato che la località tipica di *P. orsinii* appartiene al bacino adriatico come la popolazione della Puglia esaminata geneticamente. Questa specie sembra diffusa in tutte le regioni dell'Italia Meridionale (Bodon et al., 2005b). *P. antipodarum*, ora incluso nei Tateidae Thiele, 1925 (Wilke et al., 2001, 2013) è una specie alloctona invasiva, or-

mai diffusa un tutto il sud Italia (Favilli et al., 1998; Bodon et al., 2005b; Cianfanelli et al., 2007).

Nota sulla presenza del genere *Bythinella* Moquin-Tandon, 1855, in Puglia

Durante le ricerche nei bacini prossimi a quello del Cervaro, effettuate per verificare che *A. cervarensis* n. sp. non fosse limitata ad un unico bacino idrografico, è stata accertata, per la prima volta in Puglia, la presenza del genere *Bythinella* Moquin-Tandon, 1855. Questo genere, ampiamente diffuso nella penisola ma più raro al sud, dove era noto solo per la Campania, si riteneva presente con una sola specie in Italia (Giusti & Pezzoli, 1977; Bodon et al., 2005b). Recenti indagini generiche hanno confermato la presenza di *Bythinella opaca* (Gallenstein, 1848) in gran parte del territorio italiano, escluso il settore nord-occidentale (Valle d'Aosta, Piemonte e Liguria occidentale) dove è presente *Bythinella ligurica* (Pala-dilhe, 1867) (Benke et al., 2009, 2011; Bodon & Delmastro, 2013; Bank & Neubert, 2017). Al momento mancano ancora indagini genetiche per confermare lo stato specifico di molte popolazioni dell'Italia centro-meridionale.

Stazione di raccolta di *Bythinella* in Puglia

Sorgente con vasca 2 km a NNE da Roseto Valfortore, lungo la strada per Alberona, Subappennino Dauno, 885 m s.l.m. (Alberona, FG), 33T WF0982, S. Cianfanelli

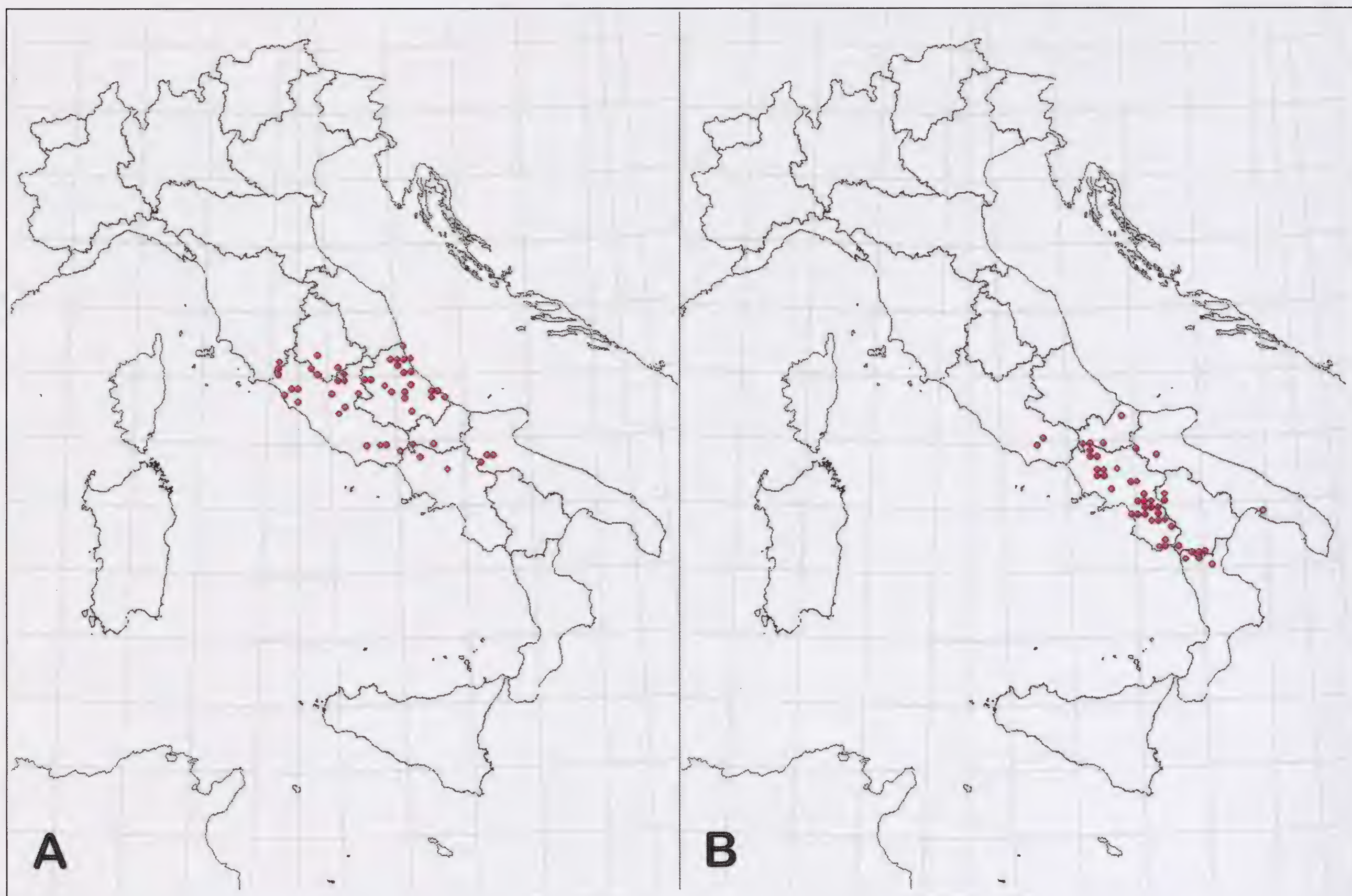


Fig. 9. Distribuzione di *Arganiella pescei* Giusti & Pezzoli, 1980 (A) e di *Belgrandia minuscula* (Paulucci, 1881) (B) su una mappa delle regioni d'Italia con reticolo UTM di 10 x 10 km. Dati da Bodon et al. (2005b), Cianfanelli & Bodon (2017), e dati personali inediti.

Fig. 9. Distribution of *Arganiella pescei* Giusti & Pezzoli, 1980 (A) and *Belgrandia minuscula* (Paulucci, 1881) (B) on UTM regional map of Italy plotted on 10 x 10 km squares. Data from Bodon et al. (2005b), Cianfanelli & Bodon (2017), and unpublished personal data.

& E. Talenti leg. 07/05/2015 (2 esemplari, 5 conch., MZUF GC/ 55048).

Conclusioni

La scoperta di un nuovo idrobiide freatobio nel sud Italia, dopo i ritrovamenti in Campania (Cianfanelli & Bodon, 2017), è un'ulteriore conferma di una più ampia diffusione di questa taxocenosi, che colonizza un ambiente peculiare, come quello delle falde alluvionali connesse ai corsi d'acqua. L'Italia meridionale è sicuramente ancora poco conosciuta, e anche alcuni reticoli minori, come quello del Torrente Cervaro esaminato in questo contesto, possono ospitare entità strettamente localizzate e ancora sconosciute per la Scienza.

La nuova specie descritta nel presente contributo dovrebbe essere tutelata, tenendo conto almeno della sua rarità e modesta area di diffusione, limitata al bacino del Torrente Cervaro. Andrà quindi valutato attentamente un possibile inserimento nelle categorie che necessitano di una adeguata protezione in base ai criteri della red-list dell'IUCN (2018). È chiaro comunque che la tutela dovrà essere mirata verso una adeguata protezione del suo habitat, anche se la maggior parte del bacino del Torrente Cervaro, quello del tratto Pugliese, è in gran parte compresa nei SIC Valle del Cervaro Bosco dell'Incoronata (IT9110032). Ciò non elimina il rischio di interventi di-

struttivi, quali alterazione degli alvei, arginature, cementificazione, distruzione della vegetazione riparia, interventi inutili e dannosi che purtroppo vengono effettuati sempre più spesso anche all'interno di aree protette.

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Fusinus fioritae n. sp. (Gastropoda: Fasciolariidae) from the central Apulia, Gulf of Taranto, Ionian sea, Mediterranean Sea

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Abstract

Fusinus fioritae n. sp. from the Gulf of Taranto, Ionian sea, coasts of Apulia, is described. This small species has shell colouring that clearly distinguishes it from all other Mediterranean species living in coralligenous environments at depths of 50-90 metres. It is compared with some other Mediterranean species. The importance of the presence and number of secondary spiral cords that do not occur regularly in individuals of the same species is discussed.

Key Words

Fusinus, new species, Ionian sea, Mediterranean sea, spiral cords.

Riassunto

Viene descritto *Fusinus fioritae* n. sp. per il Golfo di Taranto, Mare Jonio, coste pugliesi. Si tratta di una specie di piccole dimensioni con una colorazione che lo diversifica nettamente da tutte le altre specie mediterranee, vivente in ambiente coralligeno tra i 50 ed i 90 m. Viene confrontato con alcune specie mediterranee. Si discute sulla importanza della presenza e del numero delle corde spirali secondarie non regolarmente presenti in individui della stessa specie.

Parole chiave

Fusinus, nuova specie, Mare Jonio, Mare Mediterraneo, corde spirali.

Introduction

Many specimens of the genus *Fusinus* Rafinesque, 1815 (Gastropoda: Fasciolariidae) with particular characters were selected from the by-catch of trawlers operating off Porto Cesareo (Lecce) in the Gulf of Taranto, at depths of 50-90 m. This depth range is the circalittoral pre-coralligenous and coralligenous zone, rich in polychaetes (Laubier, 1966; Ballesteros, 2006) and where one finds fasciolariids that feed preferentially on these annelids (Buzzurro & Russo, 2007). Indeed, all recently described Mediterranean species, except for a few *Aegeofusinus* (Russo, 2017), come from depths between 50 and 90-100 m. The Fusininae subfamily is currently composed of 22 species in three genera, enumerated in Table 1.

Materials and methods

All the material examined was selected from the by-catch of trawlers operating in the Gulf of Taranto (Apulia). The photographs were taken with a digital camera at 24 megapixels and processed with image-editing software.

The abbreviations used in the text are: **PRC** = Paolo Russo collection (Venice, Italy); **APC** = Attilio Pagli collection (Empoli, Italy); **AFC** = Angelo Fiorita collection (Porto Cesareo, Italy); **MNHN** = Musée National d'Histoire Naturelle, Paris.

Systematics

Family Fasciolariidae J.E. Gray, 1853

Subfamily Fusininae Wrigley, 1927

Genus *Fusinus* Rafinesque, 1815

Type species by monotypy *Murex colus* Linnaeus, 1758

Fusinus fioritae n. sp.

(Fig. 1. A-R)

Note: this news species is placed in *Fusinus* in the broadest possible sense, since it bears very little resemblance to the Type: *Fusinus colus*.

Type material

Holotype: H=18.4 mm (MNHN IM-2000-34320); Paratype A, H=16.8 mm (MNHN IM-2000-34321); Paratype B, H=17.8 mm **PRC**; Paratype C, H=20.6 mm **PRC**; Paratype D, H=17.4 mm **PRC**; Paratype E, H=16.6 mm **PRC**; Paratype F, H=15.7 mm **PRC**; Paratype G, H=18.4 **PRC**; Paratype H, H=18.2 **APC**; Paratype I, H=16.6 mm **APC**; Paratype L, H=16.5 **APC**; Paratype M, H=20.0 **AFC**; Paratype N, H=18.2 **AFC**; Paratype O, H=18.6 **AFC**.

All specimens come from the type locality.

Other material examined

Several dozen specimens from **PRC**, **APC** and **AFC**, all from the type locality.

genus	species	Autor	depth	localiy	measure mm	proto µm	nucleus µm
<i>Aegeofusinus</i>	<i>angeli</i>	(Russo & Angelidis, 2016)	70/80 m	Aegean Sea	10/15 mm	660	480
	<i>eviae</i>	(Buzzurro & Russo, 2007)	50/70 m	Aegean Sea	8/12 mm	655	260
	<i>margaritae</i>	(Buzzurro & Russo, 2007)	5/10 m	Aegean Sea	10/18 mm	687	266
	<i>patriciae</i>	(Russo & Olivieri, 2013)	5/10 m	Aegean Sea	10/15 mm	580	190
	<i>profetai</i>	(Nofroni, 1982)	5/10 m	Aegean Sea	10/12 mm	600	200
	<i>rolani</i>	(Buzzurro & Ovalis, 2005)	2/45 m	Aegean Sea	10/15 mm	640	271
<i>Aptyxis</i>	<i>syracusana</i>	(Linnaeus, 1758)	2/50 m	Mediterranean sea	30/60 mm	516/845	218/340
<i>Fusinus</i>	<i>alternatus</i>	Buzzurro & Russo, 2007	70/90 m	Tyrrhenian Sea - Aegean Sea (?)	12/18 mm	613	203
	<i>buzzurroi</i>	Prckic & Russo, 2009	50/70 m	Adriatic Sea - Joanian Sea	15/20 mm	755	252
	<i>clarae</i>	Russo & Renda, 2013	70/90 m	Tyrrhenian Sea	20/30 mm	697	250
	<i>corallinus</i>	Russo & Germanà, 2014	70/90 m	Tyrrhenian Sea - Jonian Sea	15/20 mm	613	186
	<i>cretellai</i>	Buzzurro & Russo, 2008	2/5 m	Alboran Sea	15/25 mm	700	370
	<i>dimassai</i>	Buzzurro & Russo, 2007	40/50 m	Tyrrhenian Sea	10/12 mm	655	282
	<i>dimitrii</i>	Buzzurro & Ovalis, 2007	50/70 m	Aegean Sea	15/25 mm	755	312
	<i>insularis</i>	Russo & Calascibetta, 2018	70/90 m	Tyrrhenian Sea	10/20 mm	617	390
	<i>labronicus</i>	Monterosato, 1884	2/5 m	Tyrrhenian Sea	15/20 mm	628	321
	<i>parvulus</i>	Monterosato, 1884	2/5 m	Mediterranean Sea	10/18 mm	790	260
	<i>pulchellus</i>	Philippi, 1840	2/70 m	Mediterranean Sea	15/25 mm	747	300
	<i>rostratus</i>	Olivi, 1792	2/600 m	Mediterranean Sea	30/60 mm	642/914	228/521
	<i>rusticulus</i>	Monterosato, 1880	1/2 m	Goulf of Gabés (Tunisia)	15/18 mm	630	290
	<i>ventimigliae</i>	Russo & Renda, 2013	70/90 m	Tyrrhenian Sea	20/30 mm	587	175
	<i>verrucosus</i>	Gmelin, 1791	5/30 m	East Mediterranean Sea (Lebanon)	50/100 mm	untaken	untaken

Table 1. Summary of known species of the subfamily Fusininae in the Mediterranean Sea.

Tab. 1. Riassunto delle specie conosciute della sottofamiglia Fusininae nel Mediterraneo.

Type locality

An area of sea off Porto Cesareo, Lecce, Apulia, Ionian sea.

Etymology

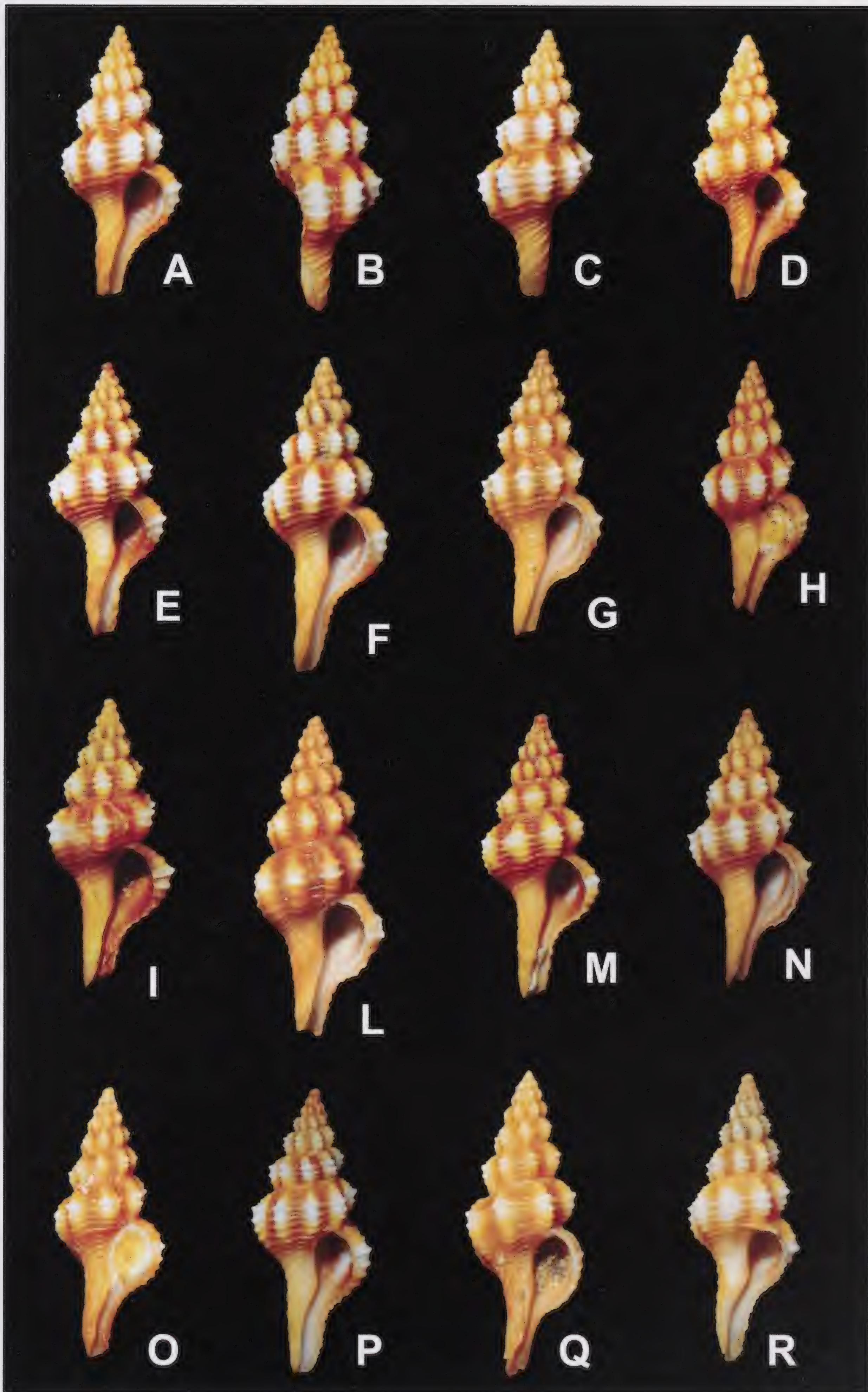
The species is dedicated to our friend Angelo Fiorita (Porto Cesareo, Lecce) who provided the study material.

Description

Shell small, rather thick, teleoconch with 6 whorls, height up to 20 mm, protoconch not planktotrophic with 1.25/1.30 whorls. Last whorl with 8 strong, raised, well-spaced axial ribs on which the supramedian spiral cord forms a slight but evident keel, completely absent on the previous whorls, except for the penultimate, where the same, but less evident, feature is sometimes visible. The axial ribs are narrow in the adapical part of

Fig. 1. A-C. *Fusinus fioritae* n. sp.: Holotype: H=18.4 mm (**MNHN IM-2000-34320**); **D.** Paratype A, H=16.8 mm (**MNHN IM-2000-34321**); **E.** Paratype B, H=17.8 mm **PRC**; **F.** Paratype C, H=20.6 mm **PRC**; **G.** Paratype D, H=17.4 mm **PRC**; **H.** Paratype E, H=16.6 mm **PRC**; **I.** Paratype F, H=15.7 mm; **L.** Paratype G, H=18.4 **PRC**; **M.** Paratype H, H=18.2 **APC**; **N.** Paratype I, H=16.6 mm **APC**; **O.** Paratype L, H=16.5 **APC**; **P.** Paratype M, H=20.0 **AFC**; **Q.** Paratype N, H=18.2 **AFC**; **R.** Paratype O, H=18.6 **AFC**.

Fig. 1. A-C. *Fusinus fioritae* n. sp.: Olotipo: H=18,4 mm (**MNHN IM-2000-34320**); **D.** Paratipo A, H=16,8 mm (**MNHN IM-2000-34321**); **E.** Paratipo B, H=17,8 mm **PRC**; **F.** Paratipo C, H=20,6 mm **PRC**; **G.** Paratipo D, H=17,4 mm **PRC**; **H.** Paratipo E, H=16,6 mm **PRC**; **I.** Paratipo F, H=15,7 mm; **L.** Paratipo G, H=18,4 **PRC**; **M.** Paratipo H, H=18,2 **APC**; **N.** Paratipo I, H=16,6 mm **APC**; **O.** Paratipo L, H=16,5 **APC**; **P.** Paratipo M, H=20,0 **AFC**; **Q.** Paratipo N, H=18,2 **AFC**; **R.** Paratipo O, H=18,6 **AFC**.



the last whorl, forming a slightly angled ramp. The last whorl bears 8 spiral cords that extend to the aperture and 18-20 that extend to the base of the siphonal canal, that is straight and not excessively long, sometimes with a slight right twist. The spiral cords are thick and raised in the abapical part of the last whorl, narrowing in the adapical part. Several secondary cords are sometimes evident, though not regularly present. The suture is elevated between the last and penultimate whorl, narrower and slightly canaliculate in the other whorls. The axial ribs are rounded from the first to the fifth whorl, extending from suture to suture and generally touch it; the spiral cords clearly overlie the axial ribs and are milky white on all whorls. On the last whorl this colour fades towards the suture, the aperture and in the central part of the intercostal space and merges into the pale reddish brown of the background; this fading is no longer evident and colour becomes uniformly whitish from the first to the third whorl. External lip varicose, aperture oval and rather wide, operculum horny and pale yellow.

Observations and conclusions

The new species is compared with small species found in the southern Tyrrhenian sea and specifically with: *F. alternatus* Buzzurro & Russo, 2007, *F. clarae* Russo & Renda in Russo, 2013, *F. corallinus* Russo & Germanà, 2014, with range extended to the Ionian sea, *F. insularis* Russo & Calascibetta, 2018, *F. parvulus* (Monterosato, 1884), *F. pulchellus* (Philippi, 1840), certain morphs of *F. rostratus* (Olivi, 1792) living in the southern Tyrrhenian Sea off north Africa and with *F. ventimigliae* Russo & Renda, 2013 of the southern Tyrrhenian (Fig. 2. A-N).

F. fioritae n.sp. differs from:

F. alternatus in shape of spire whorls, dimensions, length of siphonal canal, axial rib colouring and keel;

F. clarae in dimensions, spire whorl shape, siphonal canal length, and spiral cord number and thickness;

F. corallinus in axial rib shape, suture, colouring, and siphonal canal dimensions and thickness;

F. insularis in spiral cord colouring, shell dimensions, whorl pattern and axial rib colouring;

F. parvulus in dimensions, colouring, keel, whorl shape and environment;

F. pulchellus in spire whorl shape, general colouring, axial rib colouring and the double white cord on the whorls;

F. rostratus in dimensions, siphonal canal length, colour-

ing and aperture shape (these parameters applied to all the morphs examined);

F. ventimigliae in axial rib shape, spire whorl structure, axial ribs, colouring and suture.

The most striking characteristic of *F. fioritae* n. sp. is the colour of the axial ribs, which remains milky white on all whorls of the teleoconch, also differing from the other species by virtue of its more prominent axial ribs and spiral cords. The particular colouring of the ribs was a constant in all the specimens examined, to the point of being a determinant factor for its recognition, facilitated by high morphological stability.

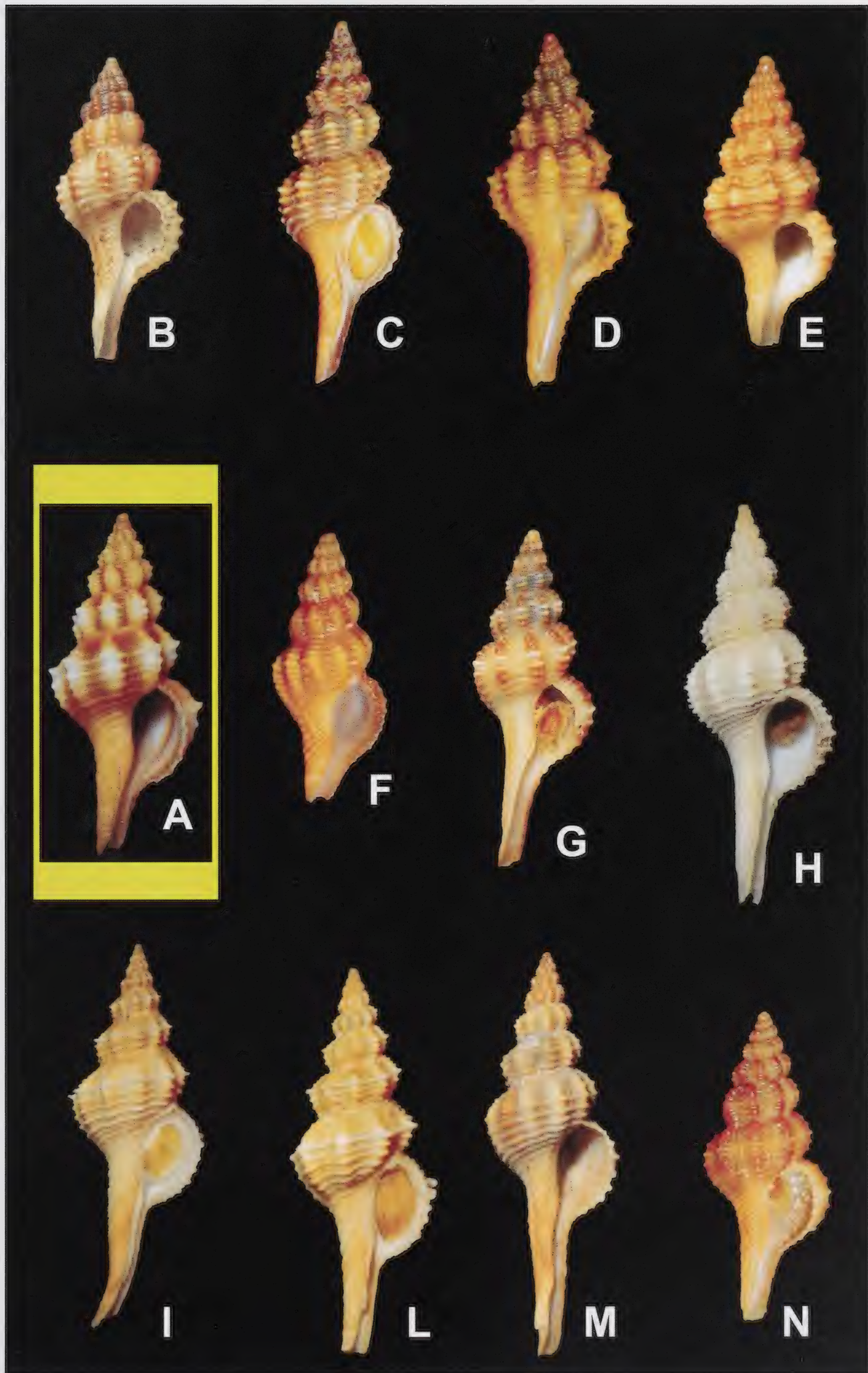
The above description mentions secondary cords, a detail found in the descriptions of other species (Russo, 2014). In relatively recent times (Buzzurro & Russo, 2007), it was postulated that the presence or absence of secondary cords could be a useful element for recognizing a species, but its subsequent observation in a great number of specimens of *Fusinus* and *Aegeofusinus* led to the conclusion that the presence or absence of this element was random. The hypothesis that it could be related to the ontogenesis of a specimen seems plausible but cannot be demonstrated statistically, since specimens with the same provenance and dimensions can have many, few or no secondary cords. The same applies to the protoconch, which in Mediterranean Fasciolaridae is always non-planktotrophic and therefore develops rapidly, so much so that it may have very similar characteristics in different species (Russo, 2018). The nucleus may differ, being variably elevated or with stripes or keels (4-6), but this can be observed in at least five species. Regarding the dimensions of the protoconch, we even find sharp differences within species (Table 1). Although in certain cases these elements can be important and must therefore be considered, they are not determinant for the classification of a species, although they may contribute to it. Only the study of all major characteristics makes it possible to distinguish one species from another. In the case of *F. fioritae* n. sp., the keys are: dimensions, siphonal canal, shell thickness, axial rib relief and colouring, slight supramedian keel (Bombace, 1971), spiral cord pattern and environment.

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Fig. 2. **A.** *F. fioritae* n. sp. H=16.6 mm, Porto Cesareo (LE); **B.** *F. alternatus* H=17.6 mm, Canale di Sicilia; **C.** *F. clarae* H=29.0 mm, Cagliari; **D.** *F. corallinus* H=19.0 mm, Marzamemi (SR); **E.** *F. insularis* H=13.8 mm, Isola delle Femmine (PA); **F.** *F. parvulus* H=12.0 mm, Porto Palo (SR); **G.** *F. pulchellus* H=18.0 mm, Acqualadroni (MS); **H.** *F. rostratus* H=38.0 mm, Civitavecchia (Roma); **I.** *F. rostratus* H=51.6 mm, Sapri (SA); **L.** *F. rostratus* H=39.0 mm, Alger Bay (Algeria); **M.** *F. rostratus* H=41.2 mm, Pozzuoli (NA); **N.** *F. ventimigliae* H=21.0 mm, Acqualadroni (MS).

Fig. 2. **A.** *F. fioritae* n.sp. H=16,6 mm, Porto Cesareo (LE); **B.** *F. alternatus* H=17,6 mm, Canale di Sicilia; **C.** *F. clarae* H=29,0 mm, Cagliari; **D.** *F. corallinus* H=19,0 mm, Marzamemi (SR); **E.** *F. insularis* H=13,8 mm, Isola delle Femmine (PA); **F.** *F. parvulus* H=12,0 mm, Porto Palo (SR); **G.** *F. pulchellus* H=18,0 mm, Acqualadroni (MS); **H.** *F. rostratus* H=38,0 mm, Civitavecchia (Roma); **I.** *F. rostratus* H=51,6 mm, Sapri (SA); **L.** *F. rostratus* H=39,0 mm, Alger Bay (Algeria); **M.** *F. rostratus* H=41,2 mm, Pozzuoli (NA); **N.** *F. ventimigliae* H=21,0 mm, Acqualadroni (MS).



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A new species of *Ischnochiton* (Mollusca: Polyplacophora) from the Pleistocene of Southern Italy

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Abstract

Based on fossil specimens collected from Archi S. Francesco (Reggio Calabria), a new species of Polyplacophora, *Ischnochiton crovatoi* n. sp., is described. The specimens were found in the sandy-pebbly marine sediments of Archi S. Francesco (located on the left side of the Valley of the river Torbido), a late Pleistocene fossil site very rich in mollusks of infralittoral to circalittoral facies. The new species is characterized by the tegmental sculpture of head valve, lateral areas of intermediate valves and postmucronal area of tail valve consisting of radial nodulose riblets. The differences between the new specie and *I. rissoi* (Payraudeau, 1826) and *I. zbyi* Dell'Angelo & Silva, 2003 are discussed.

Key words

Mollusca, Polyplacophora, Systematics, Pleistocene, Archi S. Francesco, Southern Italy.

Riassunto

Viene descritta una nuova specie di Polyplacophora, *Ischnochiton crovatoi* n. sp., basata su piastre fossili raccolte ad Archi S. Francesco (Reggio Calabria). Le piastre provengono principalmente dai sedimenti marini ciottolosi-fangosi di Archi S. Francesco (situata sul lato sinistro della valle del torrente Torbido), una località fossile Pleistocenica molto ricca di molluschi di facies infralitorale-circalitorale. La nuova specie è caratterizzata dalla scultura del tegmentum della piastra anteriore, delle aree laterali delle piastre intermedie e dell'area postmucronale della piastra posteriore costituita da strie radiali granulose. Vengono discusse le differenze tra la nuova specie e *I. rissoi* (Payraudeau, 1826) e *I. zbyi* Dell'Angelo & Silva, 2003.

Parole chiave

Mollusca, Polyplacophora, Sistematica, Pleistocene, Archi S. Francesco, Italia meridionale.

Introduction

The knowledge of the chiton fauna from the Neogene of Italy has been greatly developed in recent years, with works relating particularly to Miocene and Pliocene (Laghi, 1977; Dell'Angelo & Forli, 1996; Dell'Angelo et al., 1999, 2001, 2012, 2013, 2014, 2015, 2016; Chirli, 2004; Sosso & Dell'Angelo, 2010), while less frequent are works concerning the Pleistocene (Dell'Angelo & Palazzi, 1989, 1994; Dell'Angelo & Forli, 1995; Dell'Angelo & Giusti, 1997; 2000; Dell'Angelo et al., 1998, 2007; Dell'Angelo & Bonfitto, 2005). New research on Pleistocene deposits of the Calabrian coasts of the Strait of Messina led us to discovery numerous valves of chitons; among them a peculiar *Ischnochiton* is herein described as new.

The fossiliferous outcrops of Archi

The Late Pleistocene site of Archi, located near Reggio Calabria, Southern Italy, is well known for the clay quarry of Archi, locally known as "Fornace Aloi", located on the right side of the Valley of the river Torbido (see text-fig. 2 in Di Geronimo et al., 1997), 90 m above the sea level. It represents a paleoenvironment that can be referred to a bathyal zone, 500 to 1000 m deep (Guadagno et al., 1979; Di Geronimo et al., 1997); surveys on molluscan fauna of this area were performed by various

authors in the last few decades and are indicative of the richness of the site (Rindone & Vazzana, 1989; Dell'Angelo & Palazzi, 1989; Rindone, 1990; Di Geronimo et al., 1997; Dell'Angelo et al., 2011).

A second outcrop is located few hundred meters away on the opposite side of the Valley of the river Torbido; locally known as "Archi S. Francesco" (Fig. 1), it is also referable to a late Pleistocene (A. Vazzana, pers. com.) and is characterized by sandy-pebbly marine sediments with a rich infralittoral and circalittoral mollusc assemblage. This site is currently under study by A. Vazzana (Reggio Calabria) and his description will be included in a work on the Tirrenian of Reggio Calabria, already presented at the "Giornate di Paleontologia" organized by the S.P.I. (Società Paleontologica Italiana) in 2015 and being published.

This outcrop is scarcely documented in literature and mentioned only by some Authors as Gignoux (1913: 228): "Un petit lambeau isolé d'une terrasse marine de 100 mètres est conserve un peu au Sud de Archi, à S. Francesco, contre l'extrémité Nord-Est du massif du Pentimele", Barrier (1984: 86-88): "niveau 7: sable grossier bioclastique...", Crovato & Taviani (1985: 290): "The shells were collected in sandy-pebbly marine sediments that unconformably overlie a prevalent clayey bathyal sequence of Sicilian age. A stratigraphic and paleontological study of this unit is presently in progress; we just observe that our unit is younger



Fig. 1. View of the stratigraphic section of Archi S. Francesco along the left side of the Valley of the river Torbido. The arrow indicates the sampled section, characterized by sandy-pebbly marine sediments very rich in mollusks of infralittoral to circalittoral facies and attributed to late Pleistocene.

Fig. 1. Vista della sezione stratigrafica di Archi S. Francesco lungo il lato sinistro della valle del torrente Torbido. La freccia indica la sezione campionata, caratterizzata da sedimenti marini ciottolosi-fangosi molto ricchi di molluschi di facies da infralitorale a circalitorale e attribuiti al Pleistocene superiore.

than the Sicilian bathyal sequence and older than the Tyrrhenian terraces extensively outcropping near. Thus, the age of the study sequence is comprised between Sicilian and Tyrrhenian" and Dell'Angelo & Palazzi (1989: 41): "loc. San Francesco, con sedimenti ghiaiosi molto ricchi in molluschi da infra a circalitorali... localizzato sull'opposta sponda della vallata".

The fossiliferous deposit sampled at Archi S. Francesco (indicated by the arrow in **Fig. 1**) is exceedingly rich in remain of mollusks (for a preliminary list see Crovato & Taviani, 1985: 291-292), some of which are typical of the circalittoral environment [e.g. *Mathilda cochlaeformis* Brugnone, 1873, *M. retusa* Brugnone, 1873, *Opaliopsis atlantis* (Clench & Turner, 1952), large *Emarginula fissura* (Linnaeus, 1758), *Heliacus contextus* (L. Seguenza, 1902)], while others represent "warm" infralittoral species "(e.g. *Terebra corrugata* Lamarck, 1822, *Mitra fusiformis* (Brocchi, 1814), *Gemophos viverratus* (Kiener, 1834) (A. Vazzana, pers. com.).

Materials and methods

The chiton valves were collected some years ago (1980') by the first author and by other collectors (P. Crovato

and S. Palazzi) in the outcrops near Archi, in the course of surveys made in the frame of an extensive collecting program of mollusks in the main fossiliferous sites of the Strait of Messina area. The valves were collected both manually, inside the exposure of the sediments, and by picking after the wet-sieving (diameter 2.0, 1.0 and 0.5 mm) of bulk samples.

Scanning electron microscope (SEM) micrographs were taken using a Jeol JSM-5200.

The following abbreviations are used in the text:

- BD Bruno Dell'Angelo collection, Genova, Italy (will be deposited to MZB).
- PC Paolo Crovato collection, Napoli, Italy.
- MZB Zoological Museum of Bologna University, Bologna, Italy.

Systematics

- Order Chitonida Thiele, 1909
- Suborder Chitonina Thiele, 1909
- Superfamily Chitonoidea Rafinesque, 1815
- Family Ischnochitonidae Dall, 1889
- Genus *Ischnochiton* Gray, 1847

Type species

Chiton textilis Gray, 1828, by subsequent designation (Gray, 1847: 168). For synonymy, see Kaas & Van Belle (1990).

Distribution

The genus is known from the Eocene to the present-day, with a widespread extant circumglobal distribution, ex-

cept for the northern Atlantic and Arctic Oceans (Kaas & Van Belle, 1990).

Ischnochiton crovatoi n. sp
(Fig. 2. A-O)

Type material

Holotype MZB 50513 (tail valve, width 5.3 mm, Fig. 2.

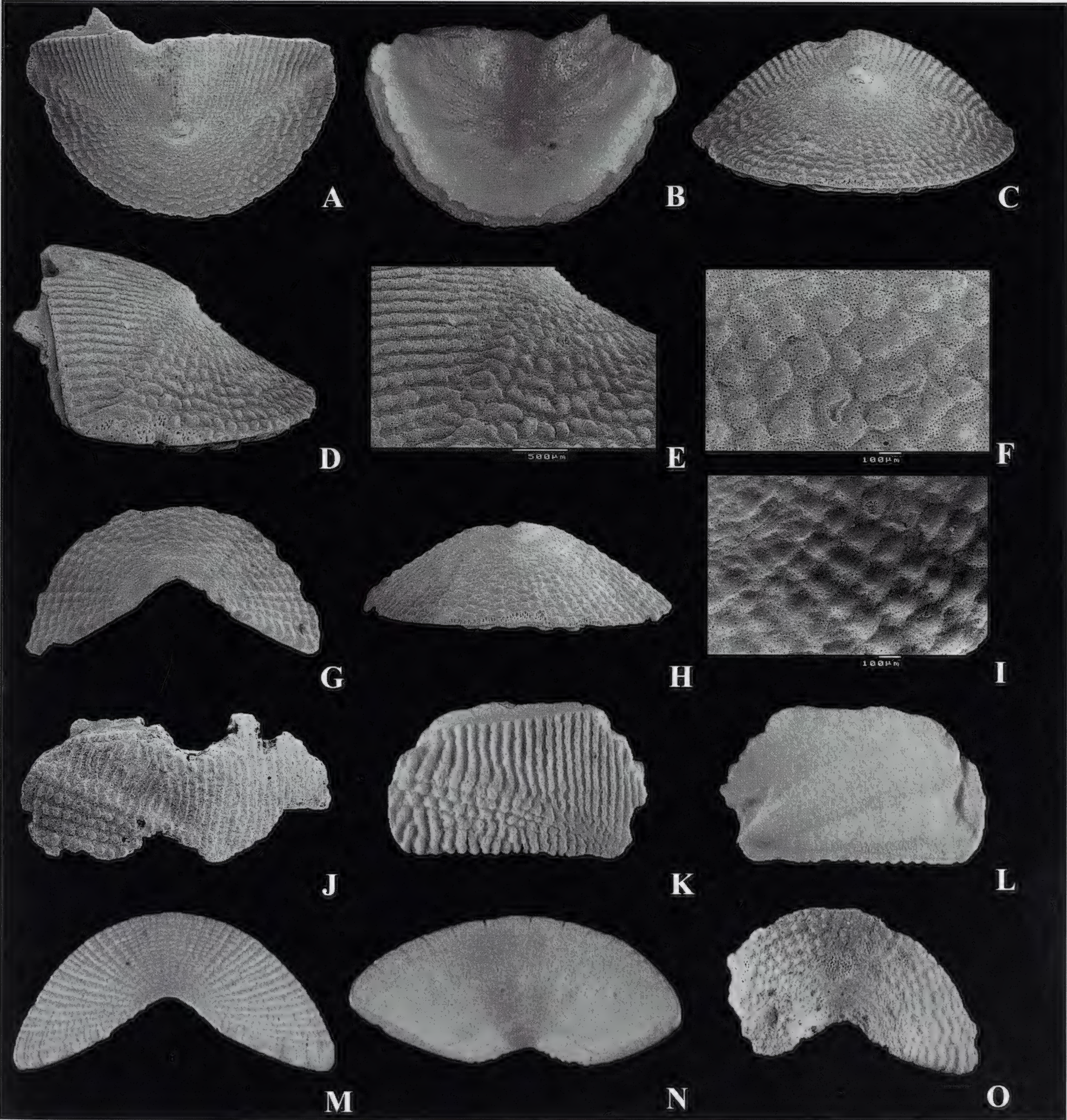


Fig. 2. A-O. *Ischnochiton crovatoi* n. sp. **A-N.** Archi S. Francesco, Reggio Calabria, S. Italy, late Pleistocene: **A-F.** Holotype, MZB 50513, tail valve, width 5.3 mm, dorsal (**A**), ventral (**B**), posterior (**C**) and lateral (**D**) views and detail of tegmentum surface in lateral view (**E**) and in postmucronal area (**F**). **G-I.** Paratype, MZB 50514, head valve, width 4.5 mm, dorsal and frontal views and detail of tegmentum surface. **J.** Paratype, MZB 50515, intermediate valve, width 5 mm, dorsal view. **K-L.** Half intermediate valve, width 3.5 mm, dorsal and ventral views. **M-N.** Head valve, width 6.8 mm, dorsal and ventral views. **O.** Archi, Fornace Aloï, Reggio Calabria, S. Italy, early Pleistocene: BD 178, head valve, width 3.8 mm, dorsal view.

Fig. 2. A-O. *Ischnochiton crovatoi* n. sp. **A-N.** Archi S. Francesco, Reggio Calabria, Italia meridionale, Pleistocene superiore: **A-F.** Olotipo, MZB 50513, piastra posteriore, larghezza 5,3 mm, viste dorsale (**A**), ventrale (**B**), posteriore (**C**) e laterale (**D**) e dettaglio della superficie del tegmentum nella vista laterale (**E**) e nell'area postmucronale (**F**). **G-I.** Paratipo, MZB 50514, piastra anteriore, larghezza 4,5 mm, viste dorsale e frontale e dettaglio della superficie del tegmentum. **J.** Paratipo, MZB 50515, piastra intermedia, larghezza 5 mm, vista dorsale. **K-L.** Mezza piastra intermedia, larghezza 3,5 mm, viste dorsale e ventrale. **M-N.** Piastra anteriore, larghezza 6,8 mm, viste dorsale e ventrale. **O.** Archi, Fornace Aloï, Reggio Calabria, Italia meridionale, Pleistocene inferiore: BD 178, piastra anteriore, larghezza 3,8 mm, vista dorsale.

A-F). Paratypes, all from the same locality: MZB 50514 (head valve, width 4.5 mm, Fig. 2. G-I); MZB 50515 (intermediate valve, width 5 mm, Fig. 2. J).

Type locality

Archi S. Francesco, Reggio Calabria, S. Italy.

Type stage

Late Pleistocene.

Etymology

Named after our friend Paolo Crovato (Napoli), who collected part of the material here studied, in recognition of his valuable contribution to the knowledge of recent and fossil malacofauna of Italy.

Other material

Archi S. Francesco: 19 valves (16 head and 3 intermediate), Fig. 2. K-N (BD, PC); Archi, Fornace Aloi (early Pleistocene): 1 head valve, Fig. 2. O (BD). Maximum width: 6.8 / 5.5 / 5.3 mm.

Description

Head valve semicircular, posterior margin widely V-shaped, front slope straight. Intermediate valves rectangular, anterior margin slightly convex, side margins rounded, posterior margin straight, apex inconspicuous, lateral areas not raised, separated from central area by the different sculpture. Tail valve semicircular, width/length ratio 1.71, anterior margin slightly convex, mucro central, swollen but not prominent, anterior slope slightly convex, posterior slope slightly concave just behind the mucro.

Tegmental sculpture consisting of radial nodulose riblets on the head valve (34-42, 34 in paratype), lateral areas of intermediate valves (5) and postmucronal area of tail valve (38 in holotype), some of which tending to split near the outer margins, the roundish to squarish nodules become larger towards the periphery. Nodulose longitudinal riblets are present on central areas of intermediate valves (ca. 20-30 on half valve, some more irregular in the part near side margin) and antemucronal area of tail valve (42 in holotype), with granules come nearer to each other, not distinctly separated.

Articulamentum with apophyses not well preserved in intermediate and tail valves, teeth irregular, slit formula: 12/1/9, poorly distinguishable in holotype, slit rays well visible.

Remarks

The studied material is in some case not well preserved or complete. The number of radial nodulose riblets on head valves is somewhat variable, ranging between 34

(paratype MZB 50514, width 4.5 mm, Fig. 2. G) and 42 (in a valve width 6.8 mm, Fig. 2. M), counting only the riblets without splitting (ca. 37-47 counted on the anterior margin). All intermediate valves found are incomplete and the number of longitudinal riblets is difficult to quantify; however, considering that in the paratype (consisting in about 2/3 of valve, Fig. 2. J) there are approximately 33 riblets and that on a second specimen, represented by an half valve 3.5 mm wide, there are about 20 (Fig. 2. K), we can estimate approximately 40 riblets on the complete valve.

The characteristic ornamentation of *Ischnochiton crovatoi* n. sp., formed by radial nodulose riblets on head valve, lateral areas of intermediate valves and postmucronal area of tail valve, distinguishes it from the common Mediterranean species *I. rissoi* (Payraudeau, 1826); in this latter species the sculpture consisting of concentric wavy lirae often crossed by fine radiating grooves, that gives to the tegmentum a granular outlook (Kaas & Van Belle, 1990; Dell'Angelo & Smriglio, 1999).

As reported by various authors (Pilsbry, 1892; Nierstrasz, 1906; Carmona Zalvide & Garcia, 1999), *I. rissoi* is a very variable species, and many synonyms exist (Kaas & Van Belle, 1990; Dell'Angelo et al., 1999). Among them, *Ischnochiton dautzenbergi* (Ancey, 1898), described on specimens collected at Port Gueydon (Algerie), appears, at first check, very similar to the new species; in *I. dautzenbergi* the lateral areas of the intermediate valves are sculptured by concentric lirae, apparently broken up into more or less regular "granulation" that giving a granulose appearance to these areas (Nierstrasz, 1906: fig. 14); moreover, the central area is sculptured by aligned vermicular ribs. In *I. crovatoi* sp. nov., on the contrary, the radial riblets on lateral areas result by an irregular alignment of real granules, without trace of concentric grooves (see Fig. 2. J) and the longitudinal riblets on the central area are formed by distinct partially merged granules and are not vermicular cords as in *I. dautzenbergi*.

Another comparable *Ischnochiton* species ornamented by granulose riblets is *I. zbyi* Dell'Angelo & Silva, 2003 from the Pliocene of Vale de Freixo, Mondego Basin, Portugal. The two species differ by the shape of the tail valve, more squared in the new species (W/L = 1.71) respect to *I. zbyi* (W/L = 2.11), the number of radial riblets on the postmucronal area, greater in *I. crovatoi* (42 vs 24-26) and, mainly, by the absence, in this latter, of any concentric grooves on the head valve, on the lateral areas of intermediate valves and on the postmucronal area of tail valve, as in *I. zbyi*.

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A new species of *Ischnochiton* (Mollusca: Polyplacophora) from the Pleistocene of Southern Italy

Parviturbo laevisculptus n. sp. (Gastropoda: Turbinidae) from the Mediterranean Sea

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Abstract

The new species *Parviturbo laevisculptus* (Gastropoda: Turbinidae) is described, based on 17 empty shells sampled in the Strait of Messina area. A further specimen of this new species is recognizable in the *Parviturbo* sp., reported by Rubio et al. (2015) from the same area, but undescribed because based on a single empty shell without protoconch. The habitat of the new species, preliminarily attributed to the coralligenous/biotrititic communities, might be further limited, due to the peculiar features of the Messina Strait, its type locality.

Key words

Gastropoda, New species, Recent, Mediterranean Sea.

Riassunto

La nuova specie *Parviturbo laevisculptus* (Gastropoda: Turbinidae) viene qui descritta sulla base di 17 conchiglie vuote campionate nello stretto di Messina. Un altro esemplare di questa nuova specie è riconoscibile nel *Parviturbo* sp., riportato da Rubio et al. (2015) per la stessa area, ma non descritto trattandosi di una singola conchiglia priva di protoconca. L'habitat della nuova specie, attribuito in via preliminare alle comunità coralligene/biotrititiche, potrebbe essere ancora più limitato, in relazione alle peculiari caratteristiche dello Stretto di Messina, sua località tipo.

Parole chiave

Gasteropodi, Nuova specie, Recente, Mediterraneo.

Introduction

The genus *Parviturbo* Pilsbry & McGinty, 1945 was deeply revised by Rubio et al. (2015), which indicated *P. fenestratus* (Chaster, 1896) and *P. alboranensis* Peñas & Rolán, 2006 as only species of this genus still recognized from the Mediterranean Sea. The same Authors, nevertheless, admitted the existence of a further undescribed species, based on an incomplete specimen from Messina. *Parviturbo elegantulus* (Philippi, 1844), described on a fossil from the Pleistocene of Pezzo, near Reggio Calabria, Italy, was discussed in the same review. In the present paper, a new species of *Parviturbo* is described based on several specimens from the Strait of Messina area, and in comparison, with the Rubio et al. (2015) undetermined specimen.

Material and methods

All studied specimens were found in sediment samples from the Strait of Messina area (Fig. 1), collected by SCUBA diving, except for the deeper one (335 m) which was sampled by a 70 dm³ van Veen grab. The sediments, consisting of a mixture of gravel and sand, were rich in bioclastic remains, with a significant rate of mollusc shells. The sorting under stereomicroscope of the rich mollusc

assemblages provided some empty shells of an indeterminate gastropod, allegedly belonging to the genus *Parviturbo*, whose morphological features are described in this paper. The specimens have been photographed by means of digital camera mounted on binocular microscope, and the photos processed by image processing. Microphotographs were performed with the scanning electron microscope (SEM) available at the Messina University.

Abbreviations and acronyms: Museum of Zoology of Bologna University (MZB); Alessandro Raveggi collection, Florence (ARF), Stefano Bartolini collection, Florence (SBF), Pasquale Micali collection, Fano (PMF); Walter Renda collection, Amantea (WRA), Benthic Ecology Laboratory, Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy (BEL).

Systematics

Superfamily Turbinoidea Rafinesque, 1815

Family Turbinidae Rafinesque, 1815

Genus *Parviturbo* Pilsbry & McGinty, 1945

type species *Parviturbo rehderi* Pilsbry & McGinty, 1945

Parviturbo laevisculptus n. sp.
(Fig. 2 A-E)

Type material

spm	H mm	D mm	site/sample	Coordinates	Depth m	repository
Holotype Fig. 2 A-E	H = 1.87		Gioia Tauro Basin, off Bagnara Calabria	38° 18' 56.23" N 15° 44' 06.31" E	335	MZB60231
Paratype 1 Fig. 3 F-G	H= 1.54		South of Scilla	38° 14' 54.86" N 15° 41' 02.61" E	41	ARF
Paratype 2	H= 0.65	D= 0.90	Costa Viola (near Scilla)	38° 14' 56.74" N 15° 40' 51.79" E	30	ARF
Paratype 3	H= 0.65	D= 0.90	Costa Viola (near Scilla)	38° 14' 56.74" N 15° 40' 51.79" E	30	ARF
Paratype 4	H= 1.62	D= 1.55	Scilla	38° 15' 27.70" N 15° 42' 44.09" E	52	SBF
Paratype 5	H= 1.54	D= 1.69	Gioia Tauro Basin, off Bagnara Calabria	38° 18' 56.23" N 15° 44' 06.31" E	335	BEL 136 POP'95 1CB
Paratype 6 Fig. 3 H	H= 1.49	D= 1.60	Gioia Tauro Basin, off Bagnara Calabria	38° 18' 56.23" N 15° 44' 06.31" E	335	WRA
Paratype 7	H= 1.44		"Grotte" north of Messina	38° 14' 07.42" N 15° 34' 43.26" E	40	PMF
Paratype 8	H= 1.60	D= 1.50	"Torre Faro" north of Messina	38° 15' 32.74" N 15° 38' 08.83" E	30	ARF
Paratype 9	H= 1.55	D= 1.55	"Torre Faro" north of Messina	38° 15' 32.74" N 15° 38' 08.83" E	30	ARF
Paratype 10	H= 1.05	D= 1.25	"Torre Faro" north of Messina	38° 15' 32.74" N 15° 38' 08.83" E	30	ARF
Paratype 11	H= 0.75	D= 0.87	"Torre Faro" north of Messina	38° 15' 32.74" N 15° 38' 08.83" E	30	ARF
Paratype 12	H= 0.75	D= 1.00	"Torre Faro" north of Messina	38° 15' 32.74" N 15° 38' 08.83" E	30	SBF
Paratype 13	H= 0.87	D= 0.90	"Torre Faro" north of Messina	38° 15' 32.74" N 15° 38' 08.83" E	30	SBF
Paratype 14	H= 1.25	D= 1.50	"Torre Faro" north of Messina	38° 16' 18.33" N 15° 39' 18.72" E	50	ARF
Paratype 15	H= 1.55	D= 1.45	"Torre Faro" north of Messina	38° 16' 18.33" N 15° 39' 18.72" E	50	ARF
Paratype 16	H= 1.17	D= 1.12	"Torre Faro" north of Messina	38° 16' 18.33" N 15° 39' 18.72" E	50	ARF

Type locality

Gioia Tauro Basin, off Bagnara Calabria (Strait of Messina, close to south-eastern Tyrrhenian sea), 38° 18' 56.23" N / 15° 44' 06.31" E; 335 m depth.

Etymology

The specific names alludes to the very delicate sculpture, in respect to the congeneric species.

Description

Only shell morphology of the new species is here described, due to the lack of living specimens:

Small, not thickened, turbiniform shell, with marked suture. Umbilicus narrow and deep. Protoconch bulbous, of a little more than 0.8 whorls, about 300 µm in diameter. Under high magnification, the surface appears covered by circular depressions forming irregular reticulate microsculpture. Protoconch-teleoconch boundary distinctly marked by the initial sculpture. Teleoconch formed by 2.5 convex whorls. Sculpture consisting of prosocline axial ribs, passing over three spiral cords, more or less marked, the abapical almost indistinguishable in the first whorl because initially close to the suture. Spiral cords variable in strength, having width about ¼ than interspaces. Space between adapical suture and first spiral cord, convex, gradually enlarging with the growth, but always 1.8 times than between first and second cord. About 20 ribs on the first teleoconch whorls, becoming more crowded with the growth, up to about 120 on the last whorl. Periphery rounded. Rib and cord intersection initially forming ir-

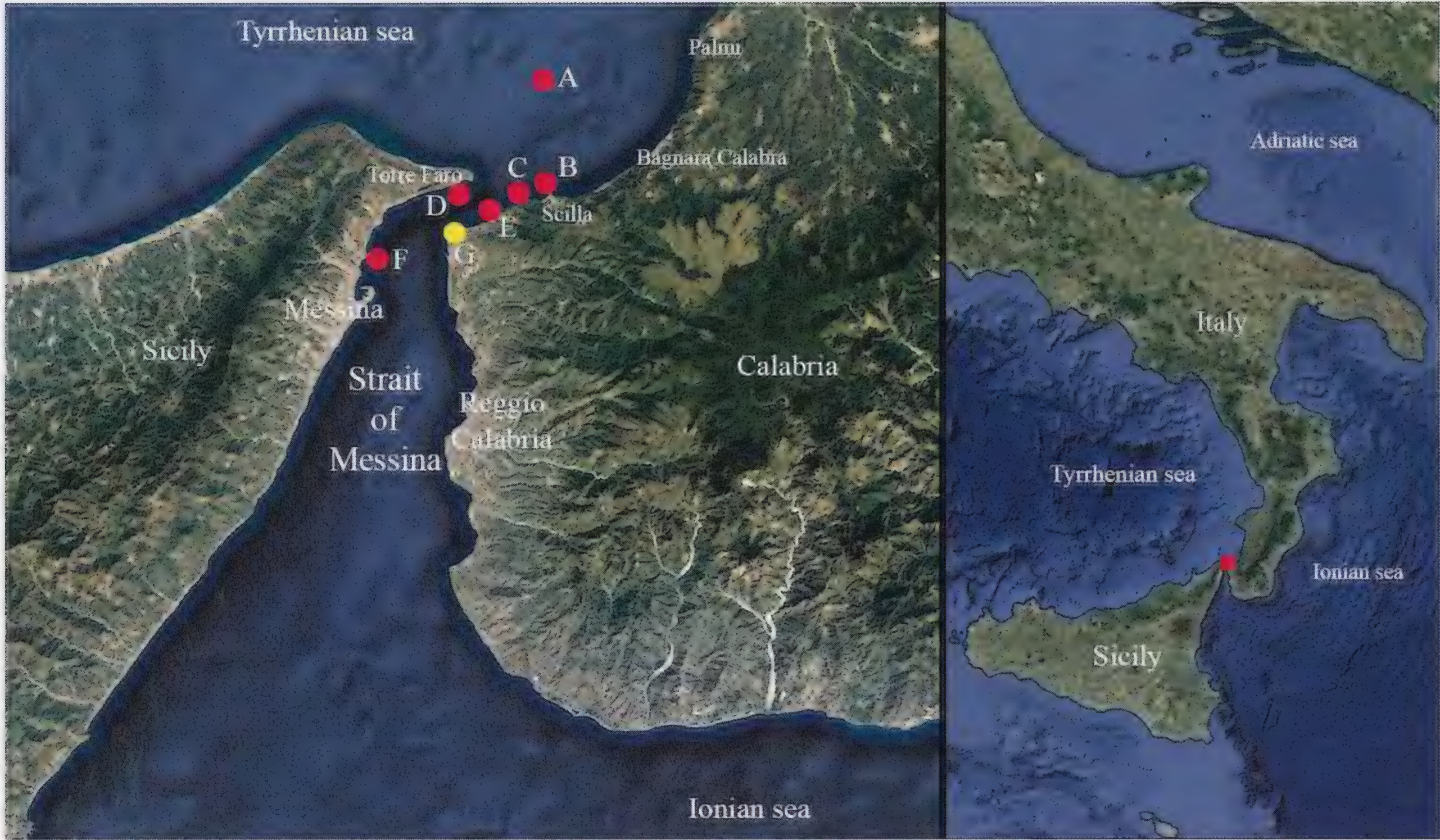


Fig. 1. Sampling stations of *Parviturbo laevisculptus* n. sp. (red circles) and sampling site of the fossil *P. elegantulus* (yellow circle). **A.** Gioia Tauro basin, off Bagnara Calabria; **B.** Scilla; **C.** South of Scilla; **D.** Torre Faro, North of Messina; **E.** Costa Viola; **F.** Grotte, North of Messina; **G.** Pezzo, near Reggio Calabria.

Fig. 1. Stazioni di campionamento di *Parviturbo laevisculptus* n. sp. (cerchi rossi) e stazione di campionamento del fossile *P. elegantulus* (cerchio giallo). **A.** bacino di Gioia Tauro, al largo di Bagnara Calabria; **B.** Scilla; **C.** Sud di Scilla; **D.** Torre Faro, Nord di Messina; **E.** Costa Viola; **F.** Grotte, Nord di Messina; **G.** Pezzo, nei pressi di Reggio Calabria.

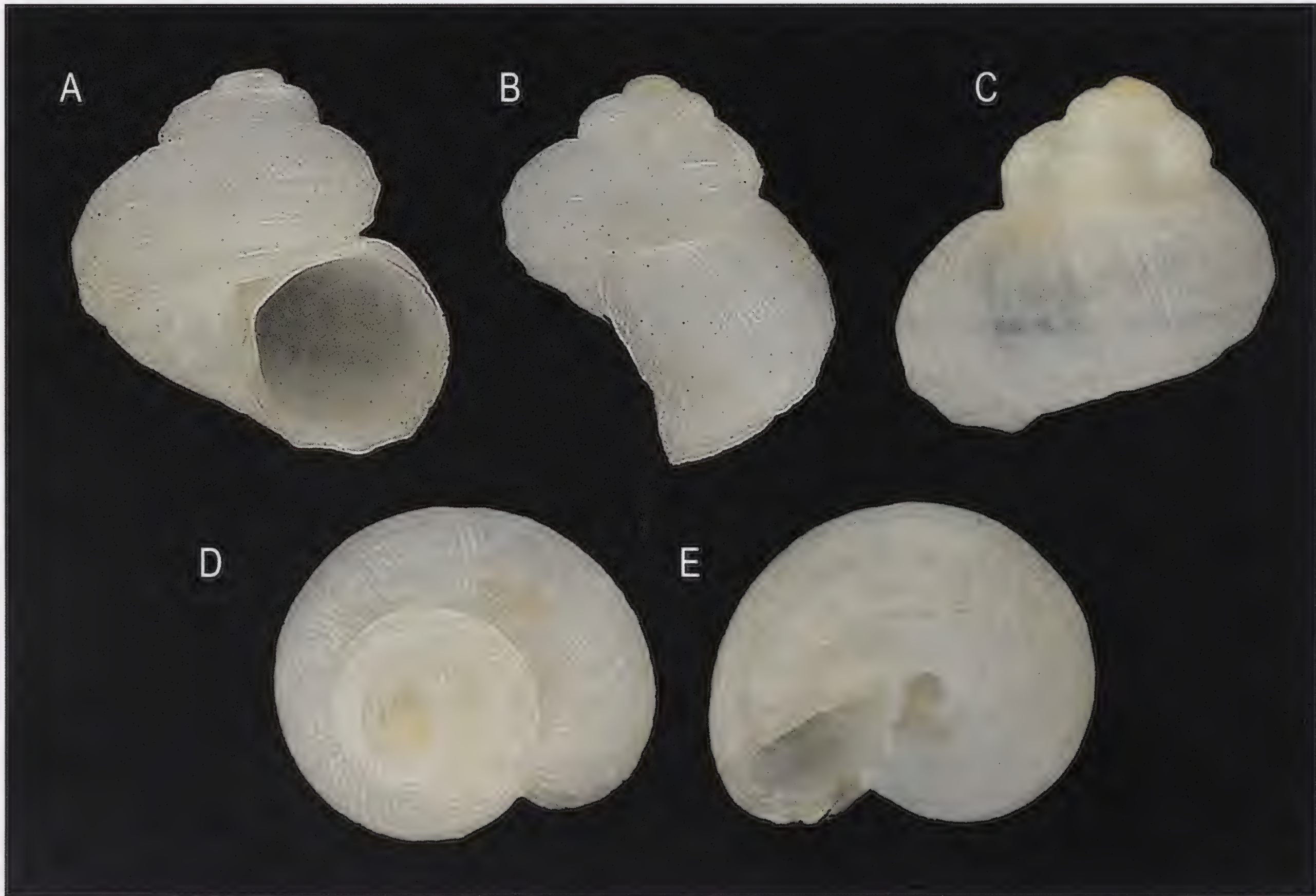


Fig. 2. A-E *Parviturbo laevisculptus* n. sp. Olotype. h = 1.87 mm. (MZB60231), type locality.

Fig. 2. A-E *Parviturbo laevisculptus* n. sp. Olotipo. h = 1,87 mm. (MZB60231), località tipo.

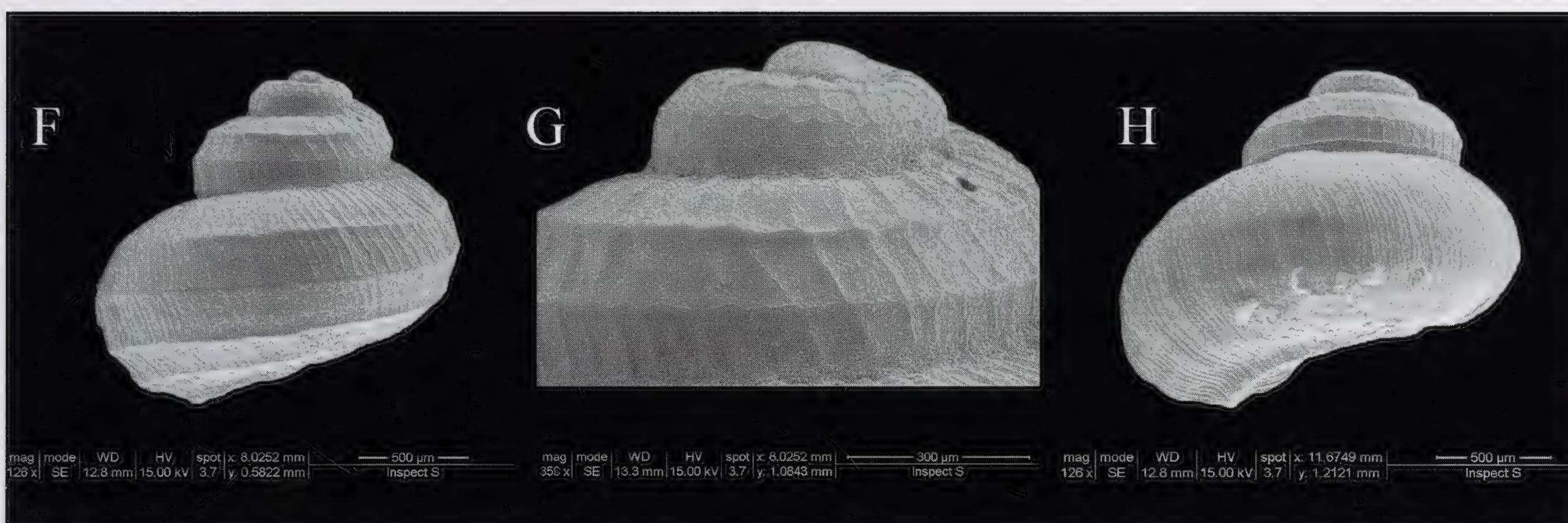


Fig. 3. F-H. *Parviturbo laevisculptus* n. sp. **F, G.** Paratype 1, h = 1.54 mm, (ARF), South of Scilla. **H.** Paratype 6, h = 1.49 mm, type locality, (WRA).
Fig. 3. F-H. *Parviturbo laevisculptus* n. sp. **F, G.** Paratipo 1, h = 1,54 mm, (ARF), a Sud di Scilla. **H.** Paratipo 6, h = 1,49 mm, località tipo, (WRA).

regularly squared (rectangular/pentagonal) cells, becoming rhomboidal in the second half whorl. Base with 3 spiral cords of different strength: the ad-apical, on the continuation of suture, similar to those on the whorls, the intermediate stronger, and the periumbilical, weaker and depressed, entering the umbilicus. Axial ribs on the whole base, entering the umbilicus. Aperture rounded, prosocline; peristoma continuous, parietal callus quite thickened, widened at the base and slightly reflected. Margin of the aperture marked by the spiral cords, especially in smaller specimens. Outer lip with a thin, simple edge.

Variability

The specimens shown in **Fig. 3 F** and **3 H** clearly indicate the remarkable variability in the strength of spiral cords and number of axial ribs. In particular, the spiral cords are well developed between 1.5 and 2.5 teleoconch whorls, tending to attenuate, and nearly vanish at the aperture. The axial ribs on the last whorl ranges from about 65 to 120, also depending from the size of specimen, because smaller specimens have less, more spaced, ribs. The width of umbilicus is also variable.

Distribution

The species is only known from biodetritic/coralligenous seafloors, 30 - 335 m depth, in the north of Messina Strait.

Discussion

The new *Parviturbo* species was first dealt with by Rubio et al. (2015), which studied the damaged specimen now designated as Paratype 7 (PMF). The Authors, which recognised its unique characteristics, admitted that “this species may be undescribed”, but lacking the protoconch they preferred to wait for more material. In its general outline, characterized by elevated spire, *P.*

laevisculptus resembles *P. elegantulus* (Philippi, 1844) **Fig. 4 J**, a species doubtfully considered as actual, which has been described on Plio-Pleistocenic material from Pezzo, a locality faced on the Strait of Messina. Other similar species is *P. fenestratus* (Chaster, 1896) **Fig. 4 I**, while *P. alboranensis* Peñas & Rolán, 2006 is much more depressed and lacks the periumbilical cords. All other Eastern Atlantic species, well discussed and figured by Rubio et al. (2015), are remarkably different. The new species differs from *P. elegantulus* for the wider, more inclined and slightly convex shoulder, the prosocline axial ribs, 3 instead of 4 spiral cords. The whorl outline, in *P. laevisculptus* is markedly carinate after about 1.5 teleoconch whorls. The protoconch is smaller in *P. elegantulus* (300 µm against 350 µm).

The comparison between the new species and *P. fenestratus* (Chaster, 1896) is complicated by the fact that the specimen figured in front view by Rubio et al. (2015 fig. 5A) is a subadult of 1.05 mm, showing a smaller spiral cordlet between the suture and the first major cord, a character that Authors define as “generally”. The new species, however, is notably different from the 1.8 mm specimen of *P. fenestratus* figured by Bogi & Nofroni (1986).

Parviturbo laevisculptus, in fact, has a the wider, more inclined and slightly convex shoulder, always lacking the smaller spiral cord between the suture and the first strong spiral cord, the spiral cords are much weaker, sometimes vanishing toward the aperture and, together with the sloping shoulder, give a more regularly curved whorl profile.

It should be noted, incidentally, that of the three specimens figured by Scaperrotta et al. (2015) as *P. fenestratus*, the one from “Capo Faro” (Messina), -30m, belongs to the new species.

The habitat of *P. laevisculptus* cannot be precisely defined, in the absence of living specimens. All dead specimens were found in detritic seafloors showing some affinities with the coralligenous environment, similarly to the other above-mentioned *Parviturbo* species. Depth range seems circalittoral, if we assume that specimens

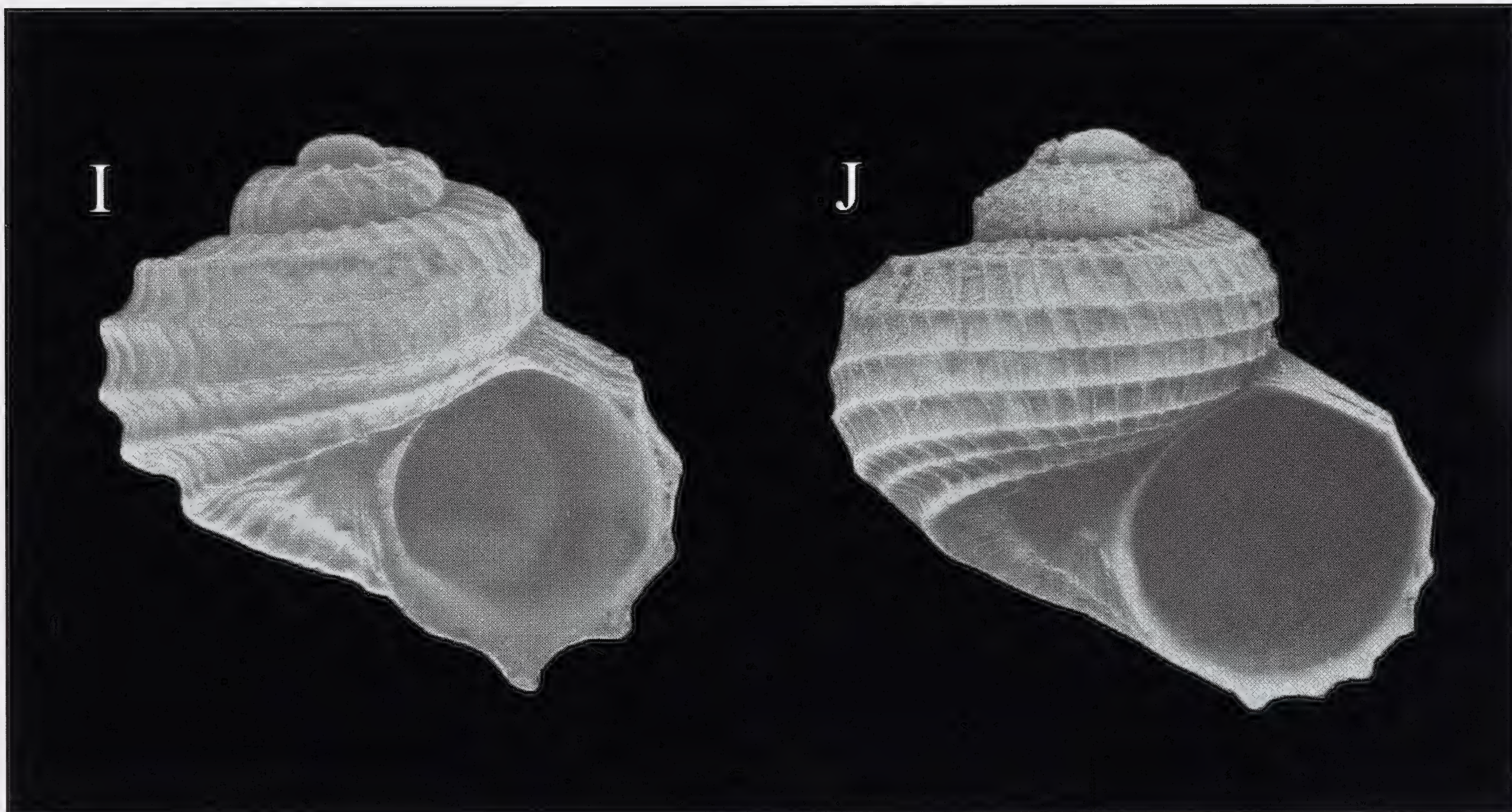


Fig. 4. I, J. *Parviturbo fenestratus* and *Parviturbo elegantulus* reproduced from Warén (1992: 202) Boll. Malac., **27** (10-12). **I.** *Parviturbo fenestratus* Punta Almina, Ceuta, 30 - 43 m, diameter 1.0 mm. **J.** *Parviturbo elegantulus* Cannitello, Plio-Pleistocene of southern Italy, coll. Monterosato, SMNH, diameter 1.7 mm.

Fig. 4. I, J. *Parviturbo fenestratus* e *Parviturbo elegantulus* riprodotti da Warén (1992: 202) Boll. Malac., **27** (10-12). **I.** *Parviturbo fenestratus* Punta Almina, Ceuta, 30 - 43 m, diametro 1,0 mm. **J.** *Parviturbo elegantulus* Cannitello, Plio-Pleistocene dell'Italia meridionale, coll. Monterosato, SMNH, diametro 1,7 mm.

found at the Gioia Tauro Basin, 335 m, could have been passively carried from shallower depths. The new species may be more linked to some edaphic factors, such as coarse substrate and high hydrodynamism, rather than a precise bathymetric range. Similarly, no evidence exists that *P. laevisculptus* is an actually living species. The habitat of *P. laevisculptus*, in fact, is unknown and probably very restricted, so that the absence in the samples of living records may be due to the sampling method or, at last, to a transient occurrence of this species in the sampled area (Giacobbe & Di Bella, 2016).

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Mauroceras, a new genus for Indo-West Pacific species hitherto assigned to *Meioceras* (Gastropoda: Caecidae)

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Abstract

The genus *Meioceras* Carpenter, 1859 has been created to include caecids from Western Atlantic showing an early teleoconch shaped like a cow's horn. Later on, *Meioceras* has been also used for species from the Indo-West Pacific showing similar teleoconch of the adult stage as the species from Western Atlantic. The finding of some larval stages pointed out some differences in terms of protoconch and early teleoconch between species from the Western Atlantic and the Indo-West Pacific. As a consequence, the new genus *Mauroceras* is proposed to include species from the Indo-West Pacific previously attributed to the genus *Meioceras*.

Keywords

Gastropoda, Caecidae, taxonomy, new genus, Indo-West Pacific.

Riassunto

[*Mauroceras*, un nuovo genere per le specie dell'Indo-Pacifico occidentale finora attribuite a *Meioceras* (Gastropoda: Caecidae)]. Il genere *Meioceras* Carpenter, 1859 venne creato per includere i Caecidae dell'Atlantico occidentale che mostravano una teleoconca iniziale a forma di corno di vacca. Successivamente, *Meioceras* venne usato anche per specie dall'Indo-Pacifico occidentale che mostravano una teleoconca dello stadio adulto simile a quello delle specie dell'Atlantico occidentale. Il ritrovamento dello stadio larvale di alcune specie ha evidenziato la presenza di alcune differenze a livello di protoconca e di teleoconca iniziale tra le specie dell'Atlantico occidentale e dell'Indo-Pacifico occidentale. Di conseguenza, il nuovo genere *Mauroceras* viene proposto per includere le specie dell'Indo-Pacifico occidentale precedentemente attribuite al genere *Meioceras*.

Parole chiave

Gastropoda, Caecidae, tassonomia, nuovo genere, Indo-Pacifico occidentale.

Introduction

The caenogastropod family Caecidae comprises tiny benthic marine species, characterized by an uncoiled tubular shell. In particular, in the subfamily Caecinae the shell is truncated several times until the adult stage is reached, so that the shell is reduced to a simple arched tube. This shape is believed to be functional to the lifestyle of caecids, which are known to live among sand grains (Morton, 1975). On the contrary, the larval shell is evenly coiled as in other caenogastropods.

At the present time, apart from the monotypic genus *Pizzinia* Vannozzi, 2017, only two genera are considered valid within this subfamily, i.e. *Caecum* Fleming, 1813 and *Meioceras* Carpenter, 1859. In fact, Absalão & Pizzini (2002) rejected all other genera of the Caecinae due to the lack of any clear set of characters. *Caecum* and *Meioceras*, especially the former, are probably non monophyletic. However, so far the taxonomy of the Caecinae has been almost completely based on shell morphology due to the lack of either genetic or anatomical data. Within this subfamily, the study is made more difficult by the fact that often only the adult stage is known, whereas young and especially larval stages are mostly unknown. This lack of knowledge hampered a more appropriate arrangement of the species within this subfamily.

The genus *Meioceras* was established by Carpenter (1859: 438) to allocate species of the subfamily Caecinae showing a peculiar cow's-horn shape of the early teleoconch, whereas in species belonging to *Caecum* s.l. the teleoconch develops almost on the same plane (Moore, 1976; Bandel, 1996). *Meioceras* was created to include species from tropical Western Atlantic, namely *M. nitidum* (Stimpson, 1851), *M. cornucopiae* Carpenter, 1859 and *M. cornubovis* Carpenter, 1859. Later on, the marquis de Folin created several other species from the same region, most of which are today considered invalid. There is no consensus about how many *Meioceras* species occur in the Western Atlantic. Moore (1976) recognized 4 valid species, *M. nitidum*, *M. cornucopiae*, *M. cubitatum* de Folin, 1868 and *M. tumidissimum* de Folin, 1869, Lightfoot (1992b) and Lester-Coll (2017) accepted three species, *M. nitidum*, *M. cornucopiae* and *M. cubitatum*, Tunnell (2010) reported two species, *M. nitidum* and *M. cornucopiae*, while Gomes (1999) considered only a single, highly variable species, i.e. *M. nitidum*. Admittedly, most authors agree that there are some morphs that cannot be attributed with certainty to one or the other species (Moore, 1972; Mitchell-Tapping, 1979; Lightfoot, 1992; De Jong & Coomans, 1988). To date, four species are considered valid for the Western Atlantic Province by the World Register of Marine Species (MolluscaBase, 2018) in agreement with Moore (1976).

The genus *Meioceras* does not occur in the Eastern Pacific (Lightfoot, 1993). It has to be noted that Lightfoot (1993) reported under this genus both *Caecum laeve* C.B. Adams, 1852 and *C. undatum* C.B. Adams, 1852, but these species were not included by Carpenter in *Meioceras* and should be therefore excluded. *Meioceras* has been used also for species from the Indo-West Pacific showing inflated shells resembling the species from the Western Atlantic. The first species described was *Meioceras elongatum* de Folin, 1881. However, this taxon has to be considered junior synonym of *M. nitidum* (Vannozzi, 2019). Other species were later described under this genus from the Central-Western Pacific Ocean: *Meioceras sandwichense* de Folin, 1881, *M. legumen* (Hedley, 1899), *M. kajiyamai* Habe, 1963, *M. boucheti* Pizzini & Raines, 2011, *M. rhinoceros* Pizzini, Raines & Vannozzi, 2013 and *M. serratum* Vannozzi, 2017. The last two species were provisionally placed within the genus *Meioceras* waiting for additional information. Moore (1976) questioned about the presence of the genus *Meioceras* in the Indo-Pacific and concluded that all species usually attributed to the genus *Meioceras* should be referred to *Fartulum* due to the lack of colour pattern. *Fartulum* was established by Carpenter (1857) for *Caecum laeve*, and is currently considered synonym of *Caecum*. *Fartulum* has been used by various authors to distinguish both *Caecum* species with smooth shells, dome-shaped septum with small mucro (Lightfoot, 1992; 1993) or caecids resembling small *Meioceras* without colour pattern (Moore, 1976; Habe, 1978). However, further research is necessary to establish its validity.

During the last two years I had the opportunity to examine the larval stages of some species from the Indo-West Pacific currently classified under the genus *Meioceras*. In particular, the larval stages of *Meioceras sandwichense*, *M. kajiyamai*, *M. boucheti* and *M. rhinoceros* were examined directly or through photograph. The results described in the present note show that all available larval stages show some common characters and differ from the larval stage of *Meioceras nitidum* reported in the literature. As a consequence, in absence of other available names, a new genus is introduced to allocate species from the Indo-West Pacific so far classified under the genus *Meioceras* and the use of the latter is restricted to species from the tropical Western Atlantic. All species from the Indo-West Pacific so far classified under the genus *Meioceras*, with the addition of *Fartu-*

lum amamiense and *Caecum maestratii* Pizzini, Raines & Vannozzi, 2013, are included in the new genus. Further, *Strebloceras kilburni* Pizzini, Raines & Vannozzi, 2013 is recognized as the young stage of *Meioceras rhinoceros* and synonymized with it.

Materials and methods

Abbreviations

The larval stages examined mainly come from material in the following collections: MNHN = Muséum National d'Histoire Naturelle, Paris, France; MP = Mauro Pizzini collection, Rome, Italy; IK = Ingo Kurtz collection, Zornheim, Germany.

The adult stage of almost all species dealt with have been recently illustrated by Pizzini et al. (2013) and Vannozzi (2017). Therefore, illustrations have been mainly limited to either larval or growth stages.

In each figure, specimens and protoconchs are reproduced at the same magnification, respectively, for an easier comparison. The number of protoconch whorls were counted according to Verduin (1982).

For the dates of publication of the Proceedings of the Zoological Society of London (1838 to 1859) and Les Fonds de la Mer, I follow Sclater (1893) and Rehder (1946), respectively.

Systematics

Class Gastropoda Cuvier, 1797

Superfamily Truncatelloidea Gray J.E., 1840

Family Caecidae Gray J.E., 1850

Subfamily Caecinae Gray J.E., 1850

Genus *Mauroceras* n. gen.

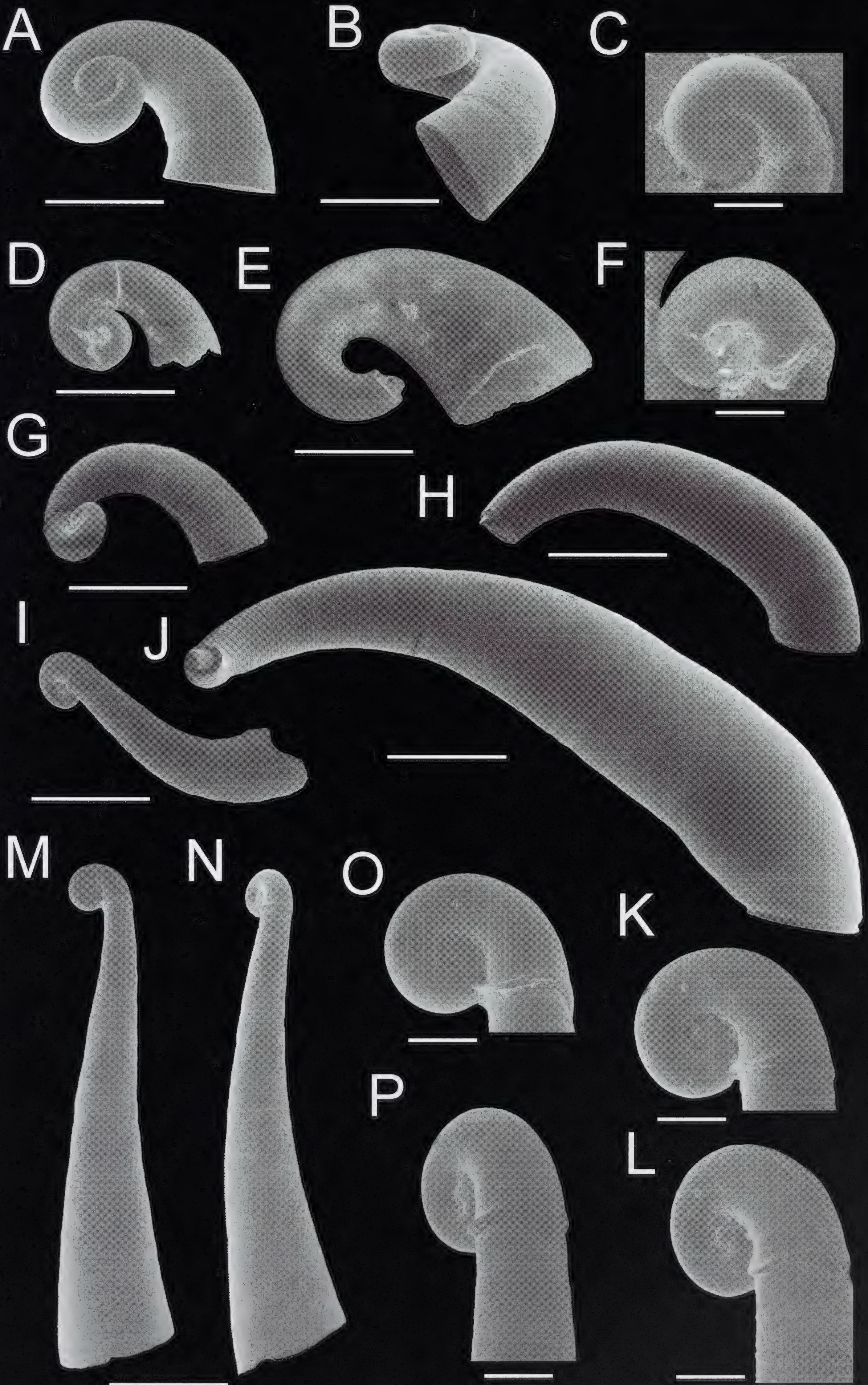
(type species *Meioceras kajiyamai* Habe, 1963).

Species included

Meioceras sandwichense de Folin, 1881, *Caecum legumen* Hedley, 1899, *M. kajiyamai* Habe, 1963, *Fartulum amamiense* Habe, 1978, *M. boucheti* Pizzini & Raines, 2011, *C. maestratii* Pizzini, Raines & Vannozzi, 2013, *M. rhinoceros* Pizzini, Raines & Vannozzi, 2013 and *M. serratum* Vannozzi, 2017. *Mauroceras kajiyamai* n. comb. has been selected as type species because it is the most common

Fig. 1. Larval, adult and growth stages of species included in the genus *Mauroceras* n. gen. **A-C.** *M. sandwichense*, larval stage, Red Sea, Abu Ramada, Hurghada, Egypt, depth 15 m (MP). **D-F.** *M. boucheti*, Arue, Tahiti, French Polynesia, depth 20 m, topotypes (courtesy D. Geiger, SBMNH); **D, F:** larval stage; **E:** early teleoconch. **G, H.** *M. amamiense*; **G:** larval stage (reproduced with permission from Geiger et al., 2007); **H:** growth stage, Urembo Is., Papua-New Guinea, depth 10 m (MNHN). **I-L.** *M. kajiyamai*; **I, K, L:** larval stage, Récif Senez, New Caledonia, depth 7 m (MNHN); **J:** growth stage, Urembo Is., Papua-New Guinea, depth 10 m (MNHN). **M-P.** *M. rhinoceros*, larval stage, Kavieng, Papua-New Guinea, depth 14-32 m (MNHN). Specimens and protoconchs are figured at the same magnification, respectively. Scale bar: 500 µm (A, B, D, E, G, H, I, J, M, N); 100 µm (C, F, K, L, O, P).

Fig. 1. Stadio larvale, adulto e stadio di crescita delle specie inserite nel genere *Mauroceras* n. gen. **A-C.** *M. sandwichense*, stadio larvale, Mar Rosso, Abu Ramada, Hurghada, Egitto, profondità 15 m (MP). **D-F.** *M. boucheti*, Arue, Tahiti, Polinesia Francese, profondità 20 m, topotipi (per gentile concessione di D. Geiger, SBMNH); **D, F:** stadio larvale; **E:** teleoconca iniziale. **G, H.** *M. amamiense*; **G:** stadio larvale (riprodotto con permesso da Geiger et al., 2007); **H:** stadio di crescita, Is. Urembo, Papua Nuova Guinea, profondità 10 m (MNHN). **I-L.** *M. kajiyamai*; **I, K, L:** stadio larvale, Récif Senez, Nuova Caledonia, profondità 7 m (MNHN); **J:** stadio di crescita, Is. Urembo, Papua Nuova Guinea, profondità 10 m (MNHN). **M-P.** *M. rhinoceros*, stadio larvale, Kavieng, Papua Nuova Guinea, profondità 14-32 m (MNHN). Esemplari e protoconche riprodotti allo stesso rispettivo ingrandimento. Scala: 500 µm (A, B, D, E, G, H, I, J, M, N); 100 µm (C, F, K, L, O, P).



and widespread species of the group and can be easily sampled for future anatomical or molecular studies.

Etymology

The new genus is named in memory of Mauro Pizzini for his contribution to the knowledge of the family Caecidae, and is composed by his given name and the Greek κέρας (horn), in assonance with *Meioceras*. Gender neuter.

Description

Shell small to large for the family, colourless to milky white. Protoconch evenly coiled, planorbid, symmetric, smooth, showing a distinct sinusigera. Growth lines wavy. Early teleoconch tubular, conical, loosely coiled to almost straight in shape, showing a light but clear sculpture composed of somewhat wavy annular ribs. Adult teleoconch tubular, arched, more or less inflated, ending with a contracted aperture. Surface smooth or with fine to strong regular rings. Aperture lip thin and reflected. No longitudinal microsculpture.

Remarks

The main distinctive characters of the new genus with respect to both *Caecum* and *Meioceras* are the planorbid protoconch showing a clear sinusigera and the presence of a sculpture of fine, slightly wavy annular ribs at least in the early teleoconch. In fact, both *Caecum* and *Meioceras* show a planorbid protoconch with no sign of sinusigera (Day, 1983; Moolenbeek et al., 1989; Hoenselaar & Hoenselaar, 1990; Bandel, 1996; Hasegawa, 2000; Kolbin & Kulikova, 2006; Scaperrotta et al., 2012; Pizzini et al., 2013; Goedert & Raines, 2016; Lima & Christoffersen, 2016; Scaperrotta et al., 2016; Vannozzi, 2017). In all species of the genus *Mauroceras* of which the larval stage is known, the protoconch is multispiral with about 1.5 whorls, suggesting a long pelagic larval phase (Thorson, 1950). This is in agreement with the wide, sometimes very wide, geographical range of *Mauroceras* species. The sinusigera is clearly visible in all available

larval specimens examined (Fig. 1 C, F, K, O). The sinusigera notch is rounded and moderately developed. Protoconch lip is thickened and becomes thin toward the beak, which is placed in the peripheral part of the protoconch (Fig. 1 L, P). Growth lines of the protoconch show the same wavy profile as the lip. The protoconch of *Mauroceras sandwichense* is most similar to the one of *M. boucheti* as far as the general aspect and size are concerned, but in the latter the sinusigera notch is deeper (Fig. 1 C, F). On the other hand, *M. kajiyaikai* and *M. rhinoceros* show a larger protoconch with similar size and shape and sharing a shallow sinusigera notch, but in the latter the beak is longer (Fig. 1 K, L, O, P).

The early teleoconch develops in different way depending on the species. In fact, in *Mauroceras sandwichense* the early teleoconch is trochospiral and after about one whorl it starts to uncoil (Figs 1 A, 2 A; Kay, 1979: fig. 42 I). However, the spiral is probably loose already as the teleoconch starts to grow and no real suture likely occurs. In *M. boucheti*, a similar development can be observed (Fig. 1 D). However, in this case the teleoconch is soon clearly separated from the protoconch and deviates from it after about 0.5 whorls. In *M. kajiyaikai*, the early teleoconch develops in a way similar to *M. nitidum* (Fig. 1 I, J). In fact, the teleoconch starts to grow almost straight after the protoconch and forms an open spiral like a cow's horn. Conversely, *M. rhinoceros* shows an extreme behaviour, as the teleoconch starts as an almost straight, conical tube and shows only a minimal abapical deviation (Fig. 1 M, N). This particular development misled Pizzini et al. (2013), who described the young stage of *M. rhinoceros* as *Strebloceras kilburni*. *M. amamiense* shows an intermediate morphology between the first and the second group of species, showing a clearly uncoiled but initially strongly curved early teleoconch (Fig. 1 G).

All species included in the new genus show a sculpture of fine ribs at least in the early teleoconch. The latter is the case of *M. sandwichense* and *M. boucheti* (Fig. 1 A, B, D, E). *M. legumen* is included in the genus due to its similarity with both *M. sandwichense* and *M. boucheti*. Moreover, the young stage of *M. legumen*, described by Hedley (1899) as *Caecum amaltheanum*, is similar to *M.*



Fig. 2. A-C. Larval and adult stages of *Mauroceras sandwichense* n. comb., Safaga, Shab Sheer reef, Egypt, depth 10-20 m (IK). A: larval stage; B, C: adult stage. Scale bar: 500 μ m.

Fig. 2. A-C. Stadio larvale e adulto di *Mauroceras sandwichense* n. comb., Safaga, Shab Sheer reef, Egitto, profondità 10-20 m (IK). A: stadio larvale; B, C: adulto. Scala: 500 μ m.

amamiense and shows a sculpture of fine ribs. However, in both *M. kajiyamai* and *M. rhinoceros* the annular sculpture is retained also in the adult shell (Fig. 1 J; Pizzini et al., 2013: fig. 16 A, C). This is also the case of *M. mae-stratii* and *M. serratum* (Pizzini et al., 2013: fig. 10 G-J; Vannozzi, 2017: fig. 3 F-L), tentatively included in the new genus due to the similarity with species in which the larval stage is known. In *M. amamiense*, the annular sculpture is visible in most cases, but smooth form also occurs (Fig. 1 G, H; Vannozzi, submitted).

In all species included in the new genus the surface of the shell shows no longitudinal microsculpture.

The Recent *Strebloceras subannulatum* de Folin, 1880 from Hawaii shows similar characters of both protoconch and early teleoconch (Vannozzi, 2016: fig. 2 E-H). However, *S. subannulatum* shows a clearly trochospiral protoconch and the shell is never truncated.

Further details can be found in Appendix.

Conclusion

The new genus *Mauroceras* is erected for species of the Caecinae from the Indo-West Pacific so far classified under the genus *Meioceras*. Eight species are included in the genus, three of which provisionally due to the lack of knowledge of the larval stage. Further, *Strebloceras kilburni* is synonymized with *M. rhinoceros*.

The new genus is characterized by a planorbid protoconch with a clear sinusigera, an early teleoconch with fine annular ribs and the absence of longitudinal microsculpture. Other characters shared by the species belonging to the new genus are the dome-shaped septum with pointed, nail-like dorsal mucro and an inclined aperture without swelling or varix.

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Appendix

Species included in the genus *Mauroceras* with completely known shell ontogeny:

Mauroceras sandwichense (de Folin, 1881) n. comb. (Figs 1 A-C, 2 A-C)

- Meioceras sandwichensis* (sic) de Folin, 1881: p. 18, pl. 1, figs 10, 11.
- Fartulum magatama* Habe, 1978: p. 2, 3, figs 7-9.
- Meioceras sandwichensis* (sic) - Kay 1979, 111, fig. 42F.
- Caecum* sp. - Kay 1979: fig. 42I.
- Meioceras sandwichense* - Pizzini & Raines, 2011: fig. 6L.
- Meioceras sandwichense* - Pizzini et al., 2013: p. 40, 42, fig. 15G.

Description

Protoconch planorbid, smooth, of 1.25 whorls, ending with a sinusigera. Sinusigera notch rounded, moderately developed. Lip thickened and reflected. Beak not visible.

Early teleoconch coiled, dextral, trochospiral, widely umbilicated. After about 1 whorl the teleoconch starts to uncoil. The early teleoconch coils around the protoconch but likely there is no real suture. The early teleoconch is coiled according to a slightly different axis with respect to the protoconch, so that the latter appears inclined. The early teleoconch shows a sculpture composed of slightly wavy collabral ribs. This sculpture is strong initially, weakens as the teleoconch grows and disappears in the adult stage. Transition to the adult shell rapid. Adult shell tubular, arched, slightly but clearly twisted in ventral view. Dorsal and ventral sides of the tube evenly arched. Septum slightly protruding, with a sharp dorsal mucro, slightly rotated toward the right side. Surface smooth, opaque, crossed by growth lines only. Aperture simple, slightly contracted, oblique, lip reflected. Operculum unknown.

Protoconch diameter 260 µm. Adult shell length 2 mm.

Distribution

Known from Red Sea, Japan and Hawaii. Although *M. sandwichense* shows a very wide distribution range, it has been rarely reported in the literature.

Mauroceras boucheti (Pizzini & Raines, 2011) n. comb. (Fig. 1 D-F)

- Meioceras boucheti* Pizzini & Raines, 2011: p. 42, fig. 6 I-K.
- Meioceras boucheti* - Pizzini et al., 2013: p. 40, fig. 15 I, J.

Description

Protoconch planorbid, smooth, of 1.25 whorls, ending with a sinusigera. Sinusigera notch rounded, deep. Lip thickened and reflected, becoming thin toward the beak.

Early teleoconch loose, dextrally coiled around the protoconch and deviating from it after about 1/2 whorl. The early teleoconch shows a sculpture of collabral ribs, rapidly vanishing as the tube grows. Transition to the adult shell rapid. Adult stage very inflated, pod shaped, showing a strong gibbosity in the dorsal side while the ventral one is slightly convex. Septum rather protruding, with a sharp dorsal mucro, slightly rotated toward the right side. Surface smooth showing growth lines only. Aperture simple, oblique, strongly contracted, lip reflected. Operculum unknown.

Protoconch diameter 260 µm. Adult shell length 1.5 mm.

Distribution

Known from Papua-New Guinea, New Caledonia, Fiji and French Polynesia.

Mauroceras amamiense (Habe, 1978) n. comb. (Fig. 1 G, H)

Fartulum amamiensis Habe, 1978: p. 3, figs 4-6.
Caecum sp. - Geiger et al., 2007: fig. 1 J.
Caecum amamiense - Pizzini et al., 2013: 17, fig. 10 E, F.
Caecum cf. *amamiense* - Vannozzi, 2017: p. 135.

Description

Protoconch planorbid, smooth, of 1.25 whorls, ending with a sinusigera, lip thickened and slightly reflected. Early teleoconch loose, dextrally coiled around the protoconch and soon deviating from it. The early teleoconch shows a sculpture of slightly wavy collabral ribs, often continuing to the adult shell. Transition to the adult shell gradual. Adult stage tubular, vitreous, opaque, slightly twisted in ventral view. Dorsal side rounded, ventral side rather straight in the middle. Septum slightly protruding, with a sharp dorsal mucro, slightly rotated toward the right side. Sculpture composed of fine, slightly wavy rings, sometimes obsolete. Aperture simple, oblique, slightly contracted, showing a slightly wavy profile. Lip reflected. Operculum unknown. Protoconch diameter about 270 µm. Adult shell length 1.5-2 mm.

Distribution

Known from Kenya, Philippines, Papua-New Guinea, Japan, New Caledonia, Fiji and Vanuatu.

***Mauroceras kajiyamai* (Habe, 1963) n. comb.
 (Fig. 1 I-L)**

Meioceras kajiyamai Habe, 1963: p. 235, fig. 5.
 †*Caecum parryensis* Ladd, 1972: p. 23, pl. 5, figs 1-7.
 †*Micranellum schlangeri* Ladd, 1972: p. 23, pl. 5, figs 13, 14.
 †*Fartulum* sp. A Ladd, 1972: p. 23, pl. 5, fig. 18.
Fartulum kajiyamai - Habe, 1978: p. 4.
Fartulum kajiyamai - Hasegawa, 2000: p. 173, pl. 86, fig. 8.
Meioceras kajiyamai - Pizzini & Raines, 2011: fig. 5 I.
Meioceras kajiyamai - Pizzini et al., 2013: p. 41, fig. 15 L, M.
Meioceras kajiyamai - Vannozzi, 2017: p. 136-138, fig. 3 A-E.

Description

Protoconch planorbid, smooth, of 1.25 whorls, ending with a sinusigera. Sinusigera notch rounded, shallow. Lip thickened, reflected, becoming thin toward the beak. Beak short, slightly extended. Early teleoconch loose, straight in adapical view and directed abapically, forming an open spiral like a cow's horn. The early teleoconch shows a sculpture of sharp regular ribs, which extends to the adult shell as regular flat rings. Transition to the adult shell rather gradual. Adult stage tubular, subcylindrical, glossy, polished,

straight in ventral view. Dorsal side convex, ventral side almost straight. The maximum diameter is reached far from the aperture, which is strongly contracted and inclined. Septum on the cutting plane, with a strong, rounded, spatulate dorsal mucro. Sculpture composed of fine, regular, flat rings with narrow interspaces. Aperture simple with reflected lip. Operculum unknown. Protoconch diameter 300 µm. Adult shell length 2.5-3.5 mm.

Distribution

From Red Sea and eastern Africa to Japan and the South-West Pacific.

***Mauroceras rhinoceros*
 (Pizzini, Raines & Vannozzi, 2013) n. comb.
 (Fig. 1 M-P)**

Meioceras rhinoceros Pizzini, Raines & Vannozzi, 2013: p. 41, fig. 16 A-C.
Strebloceras kilburni Pizzini, Raines & Vannozzi, 2013: p. 51, 53, fig. 18 H-K.
Meioceras rhinoceros - Vannozzi, 2017: p. 135, 136.

Description

Protoconch planorbid, smooth, of 1.25 whorls, ending with a sinusigera. Sinusigera notch rounded, shallow. Lip thickened, reflected, becoming thin toward the beak. Beak long, extended beyond the end of the protoconch. Early teleoconch conical, flaring, straight in adapical view and only slightly sloping abapically. The early teleoconch shows a sculpture of sharp regular ribs, rapidly vanishing with only a slight ondulation surviving to the adult shell. Transition to the adult shell gradual. Adult stage tubular, subcylindrical, glossy, polished, straight in ventral view. Dorsal side convex, ventral side almost straight. The maximum diameter is reached at about 1/3 of tube length far from the aperture, after which the tube narrows, ending with a strongly inclined aperture. Septum below the cutting plane, with a very strong, tooth-like cylindrical mucro. Surface glossy. Sculpture composed of fine, barely visible regular and flat rings with narrow interspaces. Aperture simple with reflected lip. Operculum unknown. Protoconch diameter 280 µm (excl. beak). Adult shell length 6 mm.

Distribution

Papua-New Guinea, Indonesia, Philippines.

First record of *Mitrella psilla* (Duclos, 1846) (Gastropoda: Columbellidae) in Italy

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Abstract

In this work is reported the first report regarding the *Mitrella psilla* (Duclos, 1846) presence (in Lazio, Italy). Present sightings widen the known distribution of this species, commonly found just in West Africa (from Angola to Mauritania) and in Tunisia.

Key words

Mitrella psilla, Columbellidae, Mollusca, Italy, Lazio.

Riassunto

[Primo ritrovamento di *Mitrella psilla* (Duclos, 1846) (Gastropoda: Columbellidae) in Italia]. Riportiamo per la prima volta la presenza di *Mitrella psilla* (Duclos, 1846) in Italia (Lazio). Il presente rinvenimento amplia l'areale di distribuzione di questa specie, precedentemente conosciuta solo dall'Africa Occidentale (dall'Angola alla Mauritania) e dalla Tunisia.

Parole chiave

Mitrella psilla, Columbellidae, Mollusca, Italia, Lazio.

Introduction

The Columbellidae Swainson, 1840, has been extensively reviewed by Rolán E., 2005, Hernández J. M. & Boyer F., 2005 and Pelorce J. & Boyer F., 2005, in the Lusitanic area. This authors have partially clarified the systematic position of most species, despite the fact that the Columbellidae Swainson, 1840 are a very problematic group due to the limitation of its morphological and anatomical differences. According to WORMS (accessed on 20th October 2018), 188 recent and 12 fossil species are currently placed in the genus *Mitrella* Risso, 1826, with a worldwide distribution. According to the systematic list of the Società Italiana di Malacologia (SIM) (accessed on 19th October 2018) 13 species of the genus *Mitrella* Risso, 1826 occurs in Mediterranean Sea. *Mitrella psilla* (Duclos, 1846) is a Western African species, occurring from Angola to Mauritania, only recorded in the Mediterranean Sea from the Gulf of Tunis (Antit et al., 2010).

Material and methods

Samples were collected accordingly to the "scraping" method using a standard metal reference square of 20 x 20 cm with the help of the spatula and the hammer. The material taken (three replicas per bathymetric level) is stored in pre-labeled plastic bags. The samples, collected on 14th December 2016, are stored in 75% Ethanol. Later the material is studied in September and in October 2018 in the Laboratory of Experimental Oceanology and Marine Ecology of Tuscia University, Italy. The WORMS database and the systematic list of the SIM are used for

nomenclatural updates. Sizes reported are in millimeters and given as shell height. Photos are obtained with a Nikon D80 mounted on the stereomicroscope at different depths of field, later stacked with Helicon Focus 6, and processed with Image processing.

Abbreviations and acronyms:

WORMS: World Register of Marine Species;

SIM: Società Italiana di Malacologia;

MNHN: Muséum National d'Histoire Naturelle (Paris, France).

Discussion

Thirteen species belonging to the genus *Mitrella* Risso, 1826 have been recorded in the Mediterranean Sea. *Mitrella psilla* (Duclos, 1846) is a Western African species, occurring from Angola to Mauritania, only recorded in the Mediterranean Sea from the Gulf of Tunis (Antit et al., 2010). 213 living specimens and 3 empty shells of this distinctive small-sized columbellid species are found in samples from 1 to 7 meters in depths near Forte Michelangelo, Civitavecchia harbor, Italy (N 42° 5' 17" E 11° 47' 17"). This sampling site is located in the historical part of Civitavecchia's harbor, relatively far from the main entrance of the actual port. The presence of pre-coralligenous biocostructions and high colonization rate that occurring in this site are promoted by a low tidal power, by reduced impact of maritime traffic and by the age of substrates within the area. Therefore abundant bio-concretions of red calcareous algae and colonial macro-organisms such as *Eunicella cavolini*

(Koch, 1887), *Leptogorgia sarmentosa* (Esper, 1789) and *Cladocora caespitosa* (Linnaeus, 1767), as well as vagile organisms such as *Marthasterias glacialis* (Linnaeus, 1758) and *Antedon mediterranea* are visible from 3 meters depth (Lamarck, 1816). The shallower substrates, around 1 meter of depth, are mainly colonized by *Perforatus perforatus* (Bruguière, 1789) and by few specimens of *Mytilus galloprovincialis* Lamarck, 1819, whereas the basal layer is formed by remains of dead organisms and fine sediment piled up with time. This peculiar morph-

ology, full of webs of channels and crevices, is an ideal habitat for Crustaceans (Decapoda, Anfiboda, Isopoda). At 7 meters of depth, the bio-substrate is mainly colonized by the tunicate *Microcosmus vulgaris* Heller, 1877 and from shell remains of *Spondylus gaederopus* Linnaeus, 1758 and *Ostrea edulis* Linnaeus, 1758. At this bathymetry, the substrate is dominated by pre-coralligenous of Gorgonacea, e.g. *Eunicella cavolini* (Koch, 1887) or *Leptogorgia sarmentosa* (Esper, 1789) and encrusting red algae.

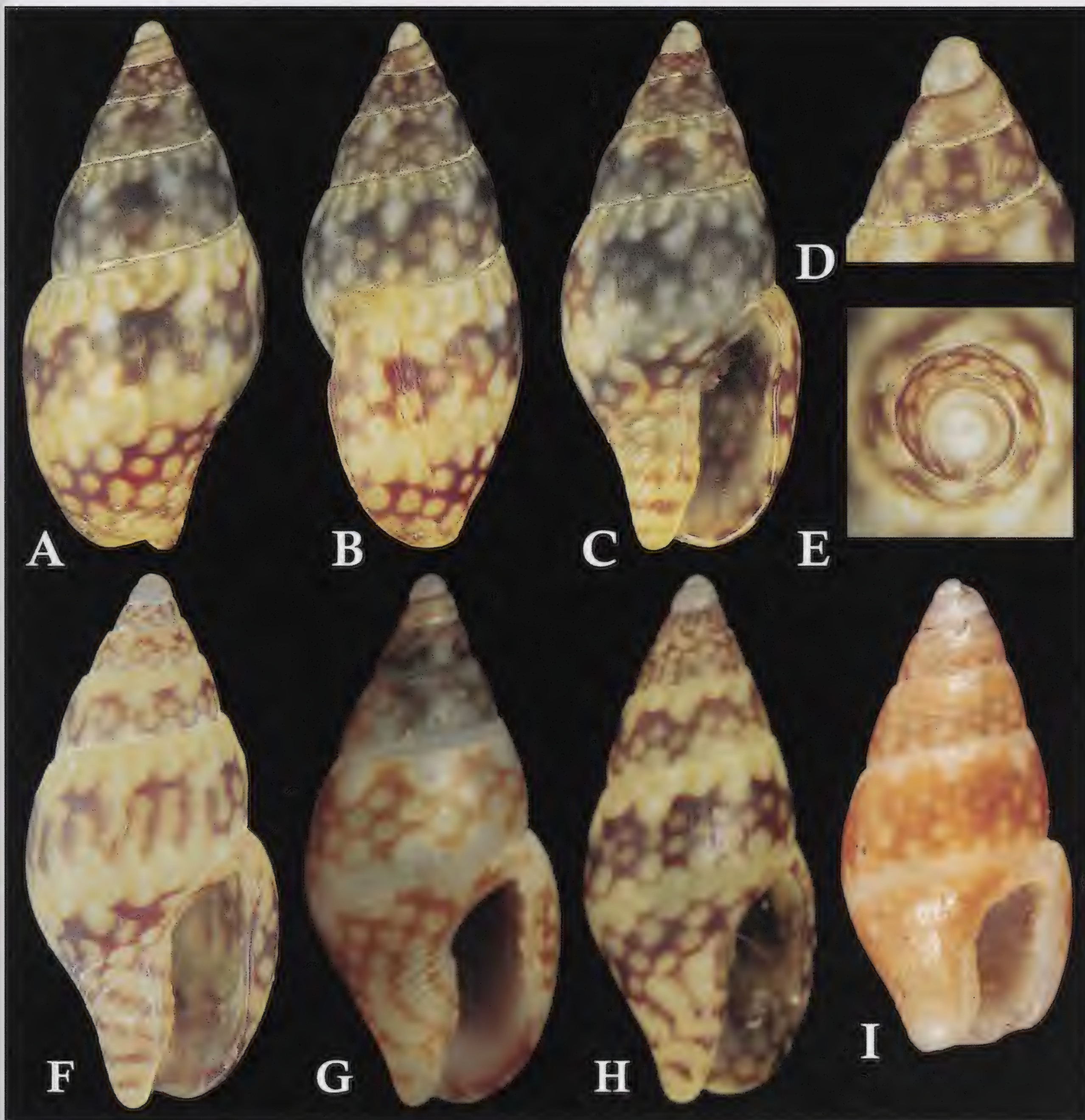


Fig. 1. A-I. *Mitrella psilla* (Duclos, 1846). **A-E.** Forte Michelangelo, Civitavecchia Harbour, Italy, 1 m, 5.8 mm; **F.** Forte Michelangelo, Civitavecchia Harbour, Italy, 7 m, 5.5 mm; **G.** Namibe, Praia das Conchas, Angola. 5.3 mm (<http://www.marine-species.org/aphia.php?p=image&tid=408445&pic=23677>); **H.** La Goulette, Tunisia, 5.4 mm (<http://www.marinespecies.org/aphia.php?p=image&tid=408445&pic=24242>); **I.** Lectotype of *Columbella psilla* Duclos, 1846. 4.8 mm MNHN-IM-2000-6396, project E-RECOLNAT: ANR-11-INBS-0004. Photographs by Mouna Antit (G-H) and Manuel Caballer (I).

Fig. 1. A-I. *Mitrella psilla* (Duclos, 1846) **A-E.** Forte Michelangelo, Porto di Civitavecchia, Italia, 1 m, 5,8 mm; **F.** Forte Michelangelo, Porto di Civitavecchia, Italia, 7 m, 5,5 mm; **G.** Namibia, Praia das Conchas, Angola. 5,3 mm (<http://www.marine-species.org/aphia.php?p=image&tid=408445&pic=23677>); **H.** La Goulette, Tunisia, 5,4 mm (<http://www.marinespecies.org/aphia.php?p=image&tid=408445&pic=24242>); **I.** Lectotipo di *Columbella psilla* Duclos, 1846. 4,8 mm MNHN-IM-2000-6396, progetto E-RECOLNAT: ANR-11-INBS-0004. Fotografie di Mouna Antit (G-H) e Manuel Caballer (I).

The studied species live in association with *Aplus assimilis* (Reeve, 1846), *Clathrella clathrata* (Philippi, 1844), *Fissurella nubecula* (Linnaeus, 1758), *Ocenebra edwardsii* (Payraudeau, 1826), *Ocenebra erinaceus* (Linnaeus, 1758), *Patella caerulea* Linnaeus, 1758, *Tritia incrassata* (Strøm, 1768), *Arca noae* Linnaeus, 1758, *Barbatia barbata* (Linnaeus, 1758), *Hiatella arctica* (Linnaeus, 1767), *Lima lima* (Linnaeus, 1758), *Lithophaga lithophaga* (Linnaeus, 1758), *Magallana gigas* (Thunberg, 1793), *Mimachlamys varia* (Linnaeus, 1758), *Mytilus galloprovincialis* Lamarck, 1819, *Ostrea edulis* Linnaeus, 1758, *Parvicardium exiguum* (Gmelin, 1791), *Petricola* sp., *Sphenia binghami* W. Turton, 1822 and *Striarca lactea* (Linnaeus, 1758).

Morphological shell features matched those of *Mitrella psilla*, thus offering us the possibility to enlarge its known distribution. This little columbellid species have few characteristic features: the protoconch is white with a dark spiral band; teleoconch has a dark background with two light band, one in the middle of the whorl and one under the suture. The pattern is composed by numerous whitish ocellations above the backrourng. The shell has a smooth shiny surface with strong spiral sculpture in the base only. The aperture is relatively elongate with teeth in both columellar and labial side. The operculum is corneous with ovoidal shape species. In bibliography, the size of the species for adult specimens is approximatively from 4.5 to 6.2 mm (Rolán, 2005; Pelorce & Boyer, 2005). In the material examined from Lazio the range is approximatively from 5 to 5.9 mm.

Considering that this species lack of a pelagic larval phase, has a direct development and the retrieval area is experiencing a remarkable traffic of boats, we are inclined to think this species could have arrived through them as suggested by Antit et al. (2009).

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Costulopsis nom. nov., a replacement name for the gastropoda genus Nanopsis Cecalupo & Robba, 2010 (Mollusca: Gastropoda: Cerithiopsidae), preoccupied by Nanopsis Henningsmoen, 1954 (Arthropoda: Ostracoda: Beyrichiidae)

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Abstract

Costulopsis Cecalupo & Robba is introduced as a replacement name for *Nanopsis* Cecalupo & Robba, 2010 (Mollusca: Gastropoda: Cerithiopsidae), which is a junior homonym of *Nanopsis* Henningsmoen, 1954 (Arthropoda: Ostracoda: Beyrichiidae). *Nanopsis* Freytag, 1974 (Arthropoda: Insecta: Cicadellidae) is another junior homonym of *Nanopsis* Henningsmoen, 1954.

Keywords

Nanopsis, *Costulopsis*, Gastropoda, Ostracoda, Insecta, homonymy.

Riassunto

Costulopsis Cecalupo & Robba viene introdotto come nome sostitutivo di *Nanopsis* Cecalupo & Robba, 2010 (Mollusca: Gastropoda: Cerithiopsidae), che è un giovane omonimo di *Nanopsis* Henningsmoen, 1954 (Arthropoda: Ostracoda: Beyrichiidae). *Nanopsis* Freytag, 1974 (Arthropoda: Insecta: Cicadellidae) è un altro omonimo minore di *Nanopsis* Henningsmoen, 1954.

Parole chiave

Nanopsis, *Costulopsis*, Gastropoda, Ostracoda, Insecta, omonimia.

Introduction

Nanopsis Cecalupo & Robba, 2010 was established as a new genus of cerithiopsid gastropods with *Cerithiopsis nana* Jeffreys, 1867 as type species. The existence of two other identical genus group names was recently revealed (Oliver et al., 2015; WoRMS 2018) for taxa in Arthropoda: *Nanopsis* Henningsmoen, 1954 (a fossil beyrichiid ostracod described from the Lower Ordovician of Norway) and *Nanopsis* Freytag, 1974 (a cicadellid leafhopper from the Nearctic Region). *Nanopsis* Henningsmoen, 1954 is a valid name in current use and contains the type species *Beyrichia nanella* Moberg & Segerberg, 1906 along with four further species: *N. coquena* Salas et al., 2007, *N. pairidaeza* Ghobadi Pour et al., 2011, *N. pilloides* (Schallreuter, 1998), and *N. victoria* Salas, 2011. Of the three cited genus names, *Nanopsis* Henningsmoen, 1954 clearly has priority and the junior homonyms *Nanopsis* Freytag, 1974 and *Nanopsis* Cecalupo & Robba, 2010 are invalid and require a new name (ICZN 1999, Article 60 of the Code). From a review of the literature, it appears that *Nanopsis* Freytag, 1974 (currently regarded as a subgenus of the genus *Pediopsoidea* Matsumura, 1912) has not received any replacement name so far. We think that finding a new name for *Nanopsis* Freytag, 1974 would be better done by the entomologists; accordingly, we abstain from doing this. Instead, we propose the new replacement name *Costulopsis* for *Nanopsis* Cecalupo & Robba, 2010.

Systematics

Genus *Costulopsis*

Cecalupo & Robba new replacement name

Nanopsis Cecalupo & Robba, 2010, p. 53; type species *Cerithiopsis nana* Jeffreys, 1867 by original designation (Mollusca: Gastropoda: Cerithiopsidae).

Non *Nanopsis* Henningsmoen, 1954, p. 54; type species *Beyrichia nanella* Moberg & Segerberg, 1906 by original designation (Arthropoda, Ostracoda, Beyrichiidae); non *Nanopsis* Freytag, 1974, p. 605; type species *Jassus verticus* Say, 1830 (Arthropoda: Insecta: Cicadellidae).

Type species. *Cerithiopsis nana* Jeffreys, 1867 automatically is the type species of *Costulopsis* (ICZN 1999, Article 67.8 of the Code).

Derivation of name

From Latin *costula* = thin rib, with reference to the subsutural axial riblets present on protoconch II; gender feminine.

Remarks

Nanopsis was originally proposed (Cecalupo & Robba 2010) to accommodate species with planktotrophic type protoconch, characterized primarily by their protoconchs II with a subsutural row of axial riblets or denticles; these species were formerly assigned to the genus *Cerithiopsis* Forbes & Hanley, 1851. Subsequent to the introduction of *Nanopsis*, some authors (Scuderi & Criscione 2011; Oliver et al. 2012; Oliver et al. 2015), criticized the use of the protoconch alone as a supraspecific character. These authors affirmed that a more modern approach involving more characters (e.g. soft-part anatomy, molecular data) is required in order to assess

any generic separation; accordingly, they preferred to reassign to the genus *Cerithiopsis* the species included in *Nanopsis* by Cecalupo & Robba (2010). It appears that most workers (cf. Rolan & Espinosa, 1995; Rolan et al., 2007; Figueira & Pimenta, 2008; Rolan & Fernández-Garcés, 2010), waiting for that more modern approach in the evaluation of systematic characters, have adopted a quite broad concept of the genus *Cerithiopsis*, which currently works as repository for a very large number of species (see *Cerithiopsis* in WoRMS 2018). To date, only one paper has dealt with the use of molecular data in separating some cerithiopsid species from one another (Modica et al., 2013). To our knowledge, no attempt was made so far to distinguish genera on the basis of soft-part anatomy and/or molecular data, and the cerithiopsid taxonomy is still in a very fluid state. Further, it is worth noting that the DNA barcoding was strongly called into question by some authors (see Will & Rubinoff, 2004; Will et al., 2005).

Having said that, we consider wise not to stay waiting for possible definition of cerithiopsid genera on the basis of the analyses advocated by the above cited authors (also having in mind the famous play by Samuel Beckett “Waiting for Godot”). Meanwhile, we are more inclined to use the characters currently available adopting a perhaps simplistic, but pragmatic approach. We think that, should a basic protoconch model be shared by several species, it likely has generic significance, minor differences being species-specific. We recall that Bouchet (1990) affirmed that “sculptural types among planktotrophic type protoconchs are considered to have taxonomic utility at supraspecific level”. Further, Bouchet et al. (2010) did not disregard the protoconch characters dealing with the cerithiopsid genus *Dizoniopsis* Sacco, 1895. Jay & Drivas (2002) in a paper devoted to the Cerithiopsidae of Reunion Island, concerning the protoconch characters, wrote: “when more material is available, these characters may be seen to be of generic significance, but in the present paper, we will consider them as minor characters”. Nevertheless, they relied on protoconch characters in proposing the new genera *Koilofera* and *Belonimorphis*. Other pertinent examples of the use of the protoconch as a generic character concern the related family Triphoriidae (see Fernandes & Pimenta, 2011, 2015).

We conclude that *Costulopsis* Cecalupo & Robba is a reasonably grounded genus worth to be in use. *Costulopsis* is now comprised of the following species:

- Costulopsis adusta* (Cecalupo & Perugia, 2018) comb. n. Original name *Synthopsis adusta*;
- Costulopsis albocincta* (Jay & Drivas, 2002) comb. n. Original name *Joculator albocinctum*;
- Costulopsis albovittata* (C. B. Adams, 1850) comb. n. Original name *Cerithium albovittatum*;
- Costulopsis ambigua* (Cecalupo & Perugia, 2013) comb. n. Original name *Synthopsis ambigua*;
- Costulopsis beneitoi* (Rolán, Espinosa & Fernández-Garcés, 2007) comb. n. Original name *Cerithiopsis beneitoi*;

- Costulopsis buzzurroi* (Cecalupo & Robba, 2010) comb. n. Original name *Nanopsis buzzurroi*;
- Costulopsis denticulata* (Cecalupo & Robba, 2010) comb. n. Original name *Nanopsis denticulata*;
- Costulopsis familiarum* (Rolán, Espinosa & Fernández-Garcés, 2007) comb. n. Original name *Cerithiopsis familiarum*;
- ? *Costulopsis granata* (Kay, 1979) comb. n. Original name *Joculator granata*;
- Costulopsis hadfieldi* (Jay & Drivas, 2002) comb. n. Original name *Cerithiopsis hadfieldi*;
- Costulopsis impedita* (Cecalupo & Perugia, 2012) comb. n. Original name *Synthopsis impedita*;
- Costulopsis* cf. *impedita* (Cecalupo & Perugia, 2012) comb. n. Original name *Synthopsis* cf. *impedita* (see Cecalupo & Perugia 2017);
- Costulopsis juxtafuniculata* (Rolán, Espinosa & Fernández-Garcés, 2007) comb. n. Original name *Cerithiopsis juxtafuniculata*;
- Costulopsis mactanensis* (Cecalupo & Perugia, 2012) comb. n. Original name *Synthopsis mactanensis*;
- Costulopsis myia* (Jay & Drivas, 2002) comb. n. Original name *Joculator myia*;
- Costulopsis nana* (Jeffreys, 1867) comb. n. Original name *Cerithiopsis nana*;
- Costulopsis noninii* (Cecalupo & Perugia, 2012) comb. n. Original name *Synthopsis noninii*;
- Costulopsis parvada* (Rolán, Espinosa & Fernández-Garcés, 2007) comb. n. Original name *Cerithiopsis parvada*;
- Costulopsis pickeringae* (Jay & Drivas, 2002) comb. n. Original name *Cerithiopsis pickeringae*;
- Costulopsis poppearum* (Cecalupo & Perugia 2012) comb. n. Original name *Clathropsis poppearum*;
- Costulopsis skolix* (Jay & Drivas, 2002) comb. n. Original name *Joculator skolix*;
- Costulopsis tenuicolorata* (Cecalupo & Perugia, 2012) comb. n. Original name *Synthopsis tenuicolorata*;
- Costulopsis* sp. Original name *Cerithiopsis* sp. 2 (see Rolán, Espinosa & Fernández-Garcés 2007, only fig. 89);
- Costulopsis* sp. Original name *Cerithiopsis tubercularis* (see Peñas et al. 2009, fig. 8);
- Costulopsis* sp. Original name *Cerithiopsis* sp. (see Oliver et al. 2012).

Concerning fossil records (Pliocene of Italy and Spain), see Cecalupo & Robba (2010).

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Two new species of *Sticteulima* Laseron, 1955 (Gastropoda: Eulimidae) from Turkey, eastern Mediterranean

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Abstract

Two eulimid gastropod species, *Sticteulima clandestina* n. sp. and *Sticteulima athenamariae* n. sp. are described as new species. These two species were found in samples of bioclastic detritus from Tusucu, Turkey. They had not been recorded earlier from this little studied region and are either endemic species or could possibly be alien lessepsian species from the Indo-Pacific or the Red Sea. The new species are compared to all the known species of the genus.

Key words

Mollusca, Gastropoda, Eulimidae, *Sticteulima*, new species, Mediterranean Sea.

Riassunto

Si descrivono due nuove specie di gasteropodi, *Sticteulima clandestina* n. sp. e *Sticteulima athenamariae* n. sp. Queste due specie sono state trovate in campioni di detrito bioclastico da Tusucu, Turchia. Si tratta della prima segnalazione per questa area geografica, si ipotizza sia che possano essere specie endemiche, sia lessepsiane. Le nuove specie sono state comparate con tutte le specie conosciute del genere *Sticteulima*.

Parole chiave

Mollusca, Gastropoda, Eulimidae, *Sticteulima*, nuove specie, Mar Mediterraneo.

Introduction

In a recent sorting out of bioclastic detritus from Tusucu, Turkey two more gastropod species from the family Eulimidae Philippi, 1853 were discovered. Presently there are only two species from the genus recorded for the Mediterranean, *Sticteulima jeffreysiana* (Brusina, 1869) and *S. lentiginosa* (Adams A., 1861), the latter an alien species from the Indo-Pacific and the Red Sea. WoRMS (World Register of Marine Species) lists 19 worldwide *Sticteulima* species. Sixteen are valid species while three are listed as *taxon inquirendum*. (Appendix 1). Unfortunately, most of these *Sticteulima* species had been published without colour images by their authors.

Material and methods

During the last few years the second author had been collecting bioclastic detritus, during scuba diving, from depths of six to eight metres from Tusucu, Turkey in the eastern Mediterranean (36°20'.00" - N 33°53'.00" E). The sampling was done by hand, by storing it in small bags during the dives. Later, the samples were dried and sorted out mostly under magnification. Among other findings (Ovalis & Mifsud in press) we found a few specimens of two different species from the genus *Sticteulima* Laseron, 1955. After profound studies on all the known species, from the Indo-Pacific, the Indian Ocean, the Red Sea, the Mediterranean and the NE Atlantic, we have concluded that these two species are new to science. One of these species, *Sticteulima clandes-*

tina n. sp. had been tentatively described and figured but not named (Ovalis & Mifsud, 2015). That figured specimen represents Paratype 1 of the present *S. clandestina* n. sp.

These two species are described herein. Measurements of the protoconch are after Verduin (1976). Measurements were taken by a digital caliper and an ocular micrometer scale fitted to the lens of a binocular microscope. The abbreviations used in the text are: M.C. = Constantine Mifsud collection (Rabat, Malta); O.P. = Panayotis Ovalis collection (Athens, Greece); NMNHM = National Museum of Natural History Mdina, Malta.

Diagnoses

Sticteulima: Shell small, about 1.5 to 3.5 mm, transparent white or opaque, protoconch with 1.5 to 2 minute whorls. Teleoconch with about six to nine whorls usually ornamented with various colour patterns or totally mono-coloured (see also remarks by Warén 1984:72). The species of the genus are parasites of ophiuroids and usually inhabit shallow depths (Bouchet & Warén 1986). Type species: *Sticteulima cameroni* Laseron, 1955 from Australia. (an image of a syntype is available here: http://seashellsofns.org.au/Eulimidae/Pages/Sticteulima_cameroni.htm)

Sytematics

Family Eulimidae Philippi, 1853
Genus *Sticteulima* Laseron, 1955

Sticteulima clandestina n. sp.

(Fig. 1. A-C)

Sticteulima species Ovalis & Mifsud 2015 fig. 2.

Material studied

All three specimens found from Tusucu, Turkey (36°20'.00" N: 33°53'.00" E), in a depth of 6 m, august 2014. leg. Ovalis P.

Holotype: h = 2.1 mm x w = 0.8 mm, deposited in the National Museum of Natural History Mdina, Malta. Collection number: NMNHM 15428.

Paratype 1: h = 1.5 mm x w = 0.5 mm in the collection of O.P.

Paratype 2: h = 1.6 mm. x w = 0.6 mm (with 2 small holes) in the collection of M.C. collection number: M1700a.

Description

Shell small, (h = 2.1 mm x w = 0.8 mm: Holotype), thin, transparent, tall and slim in morphology with a tint of yellowish-green. The protoconch consists of two whorls, (d = 0.125 mm h = 0.15 mm). There are 6 smooth, slightly expanding and nearly flat whorls. Shell slightly flattened and elliptical in cross section. Two brownish spiral bands starting just below the protoconch and ending at the middle of the aperture, encircle the whole shell. The top one more conspicuous than the other one, which is situated nearly at the middle of the whorl, and which is sometimes less conspicuous. The body whorl is about 50% of the total shell height. Aperture drop-shaped, narrow, (30% of shell height) outer lip sinuous. Columella C-shaped, with a shallow callus. The animal and its host are at present unknown.

Etymology

clandestina from clandestine meaning hidden or furtive.

Sticteulima athenamariae n. sp.

(Fig. 1. D-G)

Material studied

All four specimens found from Tusucu, Turkey (36°20'.00" N: 33°53'.00" E), in a depth of 8 m, august 2018. leg. Ovalis P.

Holotype: h = 1.7 mm x w = 0.6 mm deposited in the National Museum of Natural History Mdina, Malta. Collection number: NMNHM 15429.

Paratype 1: h = 1.8 mm x w = 0.7 mm in the collection of O.P.

Paratype 2: h = 1.9 mm x w = 0.75 mm in the collection of O.P.

Paratype 3: h = 2.1 mm x w = 0.8 mm (with a small hole and protoconch top chipped) in the collection of M.C.

Description

Shell small, (h = 1.7 mm x w = 0.6 mm: Holotype) pupoid, rather solid, opaque white. The protoconch

consists of two obtuse whorls (d = 0.1 mm x h = 0.14 mm). There are six smooth, slightly rounded, fast expanding shiny whorls, the sutures nearly inconspicuous, the body whorl is about 40% of the total shell height. There is one brownish subsutural spiral band of variable width running down the telewhorls from the protoconch and ending near the aperture as a blotch. Another spiral can also be seen present at the base of the body whorl. Aperture small, (25% of shell height) drop shaped, outer lip with a sharp edge, sometimes tinged with brown. Columella C-shaped with a thick callus. The animal and its host are presently unknown.

Etymology

athenamariae named after the second author's daughter.

Conclusion and discussion

The two brownish spiral bands separate *Sticteulima clandestina* n. sp. from the other two presently known species from the Mediterranean, *S. jeffreysiana* (Brusina, 1869) and *S. lentiginosa* (Adams A., 1861). The latter is already an established alien species in the Mediterranean (pers. obs.). A nearly similar species is *S. amamiensis* (Habe, 1961) (sensu Raines, 2002), but that species has a wide, mottled, reddish spotted spiral colour band (Fig. 1. I).

A most similar species to *S. athenamariae* n. sp. is *S. richteri* Engl W., 1997, (Fig. 1. H) but that species has narrower upper whorls with a wider spiral band, an inflated body whorl and a more elongate aperture. Moreover, it is described from the Canary Islands at the north-eastern Atlantic.

Although the new species were found in eastern Mediterranean sea habitats and could be overlooked endemics, they might just as well be new alien lessepsian species from the Red Sea and which either had been overlooked, or not encountered during Red Sea studies. These may have also entered recently through the widening of the Suez Canal and have not been documented.

There are a few species described from the Indo-Pacific, the Indian Ocean and the Red Sea which could be compared with the new species.

The figures published by Raines (2002) from Easter Island, of the species *Sticteulima amamiensis* (Habe, 1961) (WoRMS cites this species as a "taxon inquirendum"), *S. plenitora* Raines, 2002 and *Sticteulima* sp., all have a different shell ornamentation from both the new species.

Sticteulima constellata (Melvill J. C., 1898) is bigger 3.5 mm x 1 mm and the markings on the whorls consist of "regular round masses composed of red dots" (op cit.).

Sticteulima fuscopunctata (Smith E. A., 1890) is described as "is remarkable for the minute brownish scattered dots, which do not appear to be arranged in regular series." (op cit.).

In the species from Lasearon (1955), *Sticteulima cameroni* "the disposition of the coloured spots varies in individual

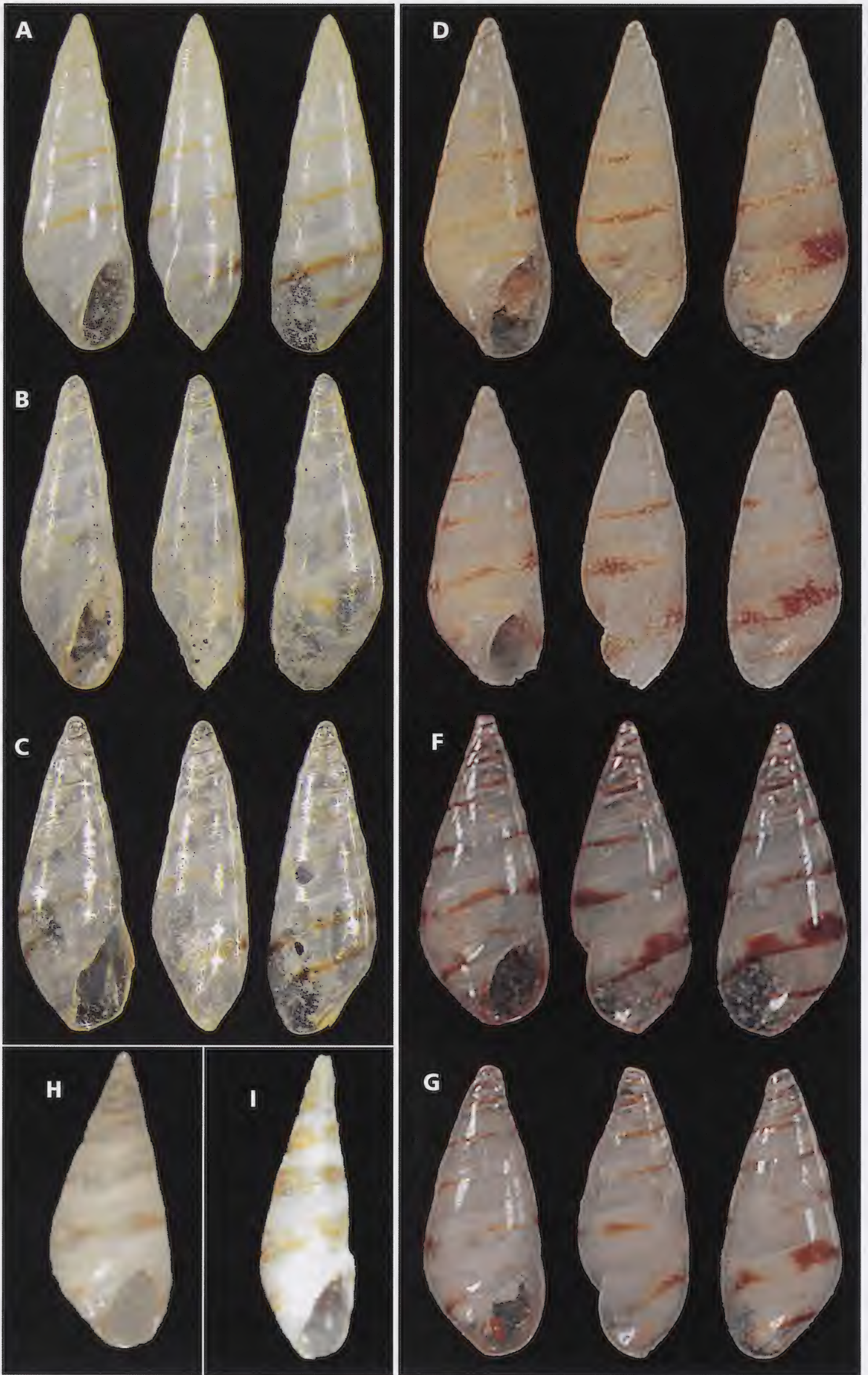


Fig. 1. A-C. *Sticteulima clandestina* n. sp. **A.** Holotype. **B.** Paratype 1. **C.** Paratype 2. **D-G.** *Sticteulima athenamariae* n. sp. **D.** Holotype. **E.** Paratype 1. **F.** Paratype 2. **G.** Paratype 3. **H.** *Sticteulima richteri* (coll. C. M.). **I.** *Sticteulima amamiensis* (after Raines 2002).

Fig. 1. A-C. *Sticteulima clandestina* n. sp. **A.** Olotipo. **B.** Paratipo 1. **C.** Paratipo 2. **D-G.** *Sticteulima athenamariae* n. sp. **D.** Olotipo. **E.** Paratipo 1. **F.** Paratipo 2. **G.** Paratipo 3. **H.** *Sticteulima richteri* (coll. C. M.). **I.** *Sticteulima amamiensis* (da Raines 2002).

shells, they are sometimes isolated, at other times segregated into irregular patches, or they may be partially confluent in lines". *S. portensis* "is yellow" while *S. incidenta* "has a white to yellowish texture, vitreous and transparent" (op. cit.) Images of these species are available here: <http://seashellsofnsw.org.au/index.htm>

Sticteulima piperata (Sowerby G. B., 1901), described from Cebu "is white with groups of small chocolate dots clustered around the periphery" (op. cit.).

Sticteulima piperita (Hedley C., 1909) described from Australia, "is profusely speckled with small reddish-brown spots" (op. cit.).

Sticteulima spreta (Adams A., 1864) described from Japan "has the whorls obscurely banded" (op. cit.).

Acknowledgements

Thanks are due to the many members of the Mollusca-L listserver for providing the various important literature pertaining to our study. A special thanks to Andrea Nappo (Rome) for the images of the type material, and thanks also to Cachia C. (Malta) for revising the manuscript.

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Addenda

List of worldwide *Sticteulima* species recorded in WoRMS (World Register of Marine Species) with locality distribution.

There are 19 Species, 16 are valid and 3 are listed as "taxon inquirendum"

Sticteulima amamiensis (Habe, 1961) (*taxon inquirendum*) Japan, Easter Island

Sticteulima ariel (A. Adams, 1861) (*taxon inquirendum*) Japan

Sticteulima australiensis (Thiele, 1930) Australia

Sticteulima badia (R. B. Watson, 1897) NE Atlantic

Sticteulima cameroni Laseron, 1955 Australia

Sticteulima constellata (Melvill, 1898) Aden ? Indian Ocean

Sticteulima fuscopunctata (E. A. Smith, 1890) St Helena Is., South Atlantic

Sticteulima incidenta (Laseron, 1955) Australia

Sticteulima interrupta (A. Adams, 1864) (*taxon inquirendum*) Japan

Sticteulima jeffreysiana (Brusina, 1869) NE Atlantic, Mediterranean

Sticteulima lata Bouchet & Warén, 1986 NE Atlantic: Selvagens Islands

Sticteulima lentiginosa (A. Adams, 1861) Indo-Pacific, Mediterranean

Sticteulima piperata (Sowerby, 1901) Cebu, Philippines

Sticteulima piperita (Hedley, 1909) Australia

Sticteulima plenicolora Raines, 2003 Easter Island

Sticteulima portensis (Laseron, 1955) Australia

Sticteulima richteri Engl, 1997 Canary Islands

Sticteulima spreta (A. Adams, 1864) Japan

Sticteulima wareni Engl, 1997 NE Atlantic

The family Caecidae (Mollusca: Gastropoda) from northern Papua-New Guinea

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Abstract

The Caecidae collected during PAPUA-NIUGINI (2012) and KAVIENG (2014) Expeditions conducted by the Muséum National d'Histoire Naturelle, Paris, in the North Papua-New Guinea are reported. Thirty-seven species are recognized, of which 23 belong to the genus *Caecum*, 6 to the genus *Mauroceras* and 8 to the genus *Parastrophia*. Six species are described as new, all belonging to the genus *Caecum*: *C. directum*, *C. frugi*, *C. granulatum*, *C. nasutum*, *C. neoguineanum* and *C. nofronii*. One species is left undetermined, waiting for additional material. Further, *Parastrophia cornucopiae* (de Folin, 1869) is recognized and figured for the first time since its description.

Keywords

Gastropoda, Caecidae, taxonomy, new species, Papua-New Guinea.

Riassunto

[La famiglia Caecidae (Mollusca: Gastropoda) nella Papua Nuova Guinea settentrionale].

Sono descritte e presentate le specie appartenenti alla famiglia Caecidae raccolte nell'ambito di due spedizioni oceanografiche del Museo Nazionale di Storia Naturale di Parigi negli anni 2012 e 2014 nel nord della Papua Nuova Guinea.

Trentasette sono le specie presenti nel materiale studiato, delle quali 23 appartenenti al genere *Caecum*, 6 al genere *Mauroceras*, recentemente introdotto per includere le specie dell'Indo Pacifico Occidentale finora inserite del genere *Meioceras*, e 8 al genere *Parastrophia*. Sei di queste specie vengono descritte come nuove, tutte appartenenti al genere *Caecum*: *C. directum*, *C. frugi*, *C. granulatum*, *C. nasutum*, *C. neoguineanum* e *C. nofronii*. Un'ulteriore specie incognita viene illustrata ma non descritta in attesa di materiale aggiuntivo.

Inoltre *Parastrophia cornucopiae* (de Folin, 1869) viene illustrata per la prima volta dalla sua descrizione.

Parole chiave

Gastropoda, Caecidae, tassonomia, nuove specie, Papua Nuova Guinea.

Introduction

The family Caecidae includes very small meiobenthic gastropods which are known to live among sand grains and detritus, feeding on diatoms (Draper, 1979). Typical adult size is 2 to 4 mm. In this family, the adult shell is very loosely coiled and mostly consists of a slightly arched simple tube. Within the subfamily Caecinae, the shell is truncated and only the last stage is retained. In fact, during the growth, the early portions of the tubular shell are discarded from time to time and the posterior end is closed by a calcareous septum. On the contrary, in subfamilies Strebloceratinae and Ctiloceratinae the shell is never truncated and also the protoconch is preserved (Draper, 1985; Bandel, 1996; Pizzini et al., 1998).

Papua-New Guinea (PNG) is a territory in the western Pacific Ocean including the eastern half of the island of New Guinea and some islands such as New Britain and New Ireland. The northern region of this country around the Bismark sea has been investigated during two recent expeditions carried out by the Muséum National d'Histoire Naturelle, Paris, i.e. PAPUA-NIUGINI (2012) and KAVIENG (2014) in the framework of the project

"Our Planet Reviewed". This work reports on the Caecidae from northern Papua-New Guinea, with the description of six new species.

Material and methods

Taxonomy within the family Caecidae is so far almost entirely based on shell characters, among which general shape, sculpture, microsculpture, shape of the aperture, shape of septum and mucro (subfamily Caecinae) and protoconch are mostly used.

This work is based on the material collected during the PAPUA-NIUGINI (2012) and KAVIENG (2014) Expeditions carried out by the Muséum National d'Histoire Naturelle, Paris (MNHN). On the whole, it consists of 2600 specimens collected in 167 stations covering a depth range of 0-60 m. Details on the stations, including locality, coordinates, depth, substrate and collecting methods are listed in Appendix 2. Further information on the expeditions can be found at <http://expeditions.mnhn.fr/>.

All examined material is deposited in the MNHN unless otherwise reported.

In each figure, specimens are reproduced at the same magnification to allow an easier comparison. The number of protoconch whorls were counted according to Verduin (1982). Distributions are based on both examined material and published literature listed in the synonymy of each species.

For the dates of publication of the Proceedings of the Zoological Society of London (1838 to 1859) and Les Fonds de la Mer, I have followed Sclater (1893) and Rehder (1946), respectively. Citation of authorship of taxa follows Coan (1972).

Abbreviations

colln = collection; diam = diameter; fragm = fragment; gs = growth stage; I: island; IWP = Indo-West Pacific; juv = juvenile specimen(s); leg = legit; lv = live-collected specimen(s); max = maximum; min = minimum; ph = material examined through photograph; PNG = Papua-New Guinea; sh = empty shell(s).

Repositories

AMS = Australian Museum, Sydney, Australia; LACM = Natural History Museum of Los Angeles County, U.S.A.; MNHN = Muséum National d'Histoire Naturelle, Paris, France; NHMUK = Natural History Museum, London, UK, formerly BMNH; MSNIT = Museo di Storia Naturale dell'I.T. G.B. Della Porta, Naples, Italy; MZB = Museo di Zoologia dell'Università di Bologna, Bologna, Italy; NMNS = National Museum of Nature and Science, Tokyo, Japan, formerly NSMT; IK = Ingo Kurtz colln, Zornheim, Germany; IN = Italo Nofroni colln, Rome, Italy; IP = Ivan Perugia colln, Ravenna, Italy; MP = Mauro Pizzini colln, Rome, Italy.

Terminology

Coiled protoconch = the early coiled portion of the protoconch in the subfamily Ctiloceratinae; cutting plane = plane defined by the edge of the shell at the apex in the point of truncation occurring in the subfamily Caecinae (Nofroni et al., 1997); dorsal side = convex side of the tube (or protoconch); macula = spot placed in the middle of the ventral side of the tube (Vannozzi et al., 2015); mucro = appendage often visible on the septum; septum = closure of the posterior end of the shell after the previous stage is discarded; uncoiled protoconch = the late uncoiled section of the protoconch in the subfamily Ctiloceratinae following the coiled protoconch, clearly distinct from the teleoconch, from which it is mostly separated by a varix; ventral side = concave side of the tube (or protoconch); left and right sides are referred to with respect to the ventral side with the apex upwards.

Systematics

Class Gastropoda Cuvier, 1797
Superfamily Truncatelloidea Gray J.E., 1840

Family Caecidae Gray J.E., 1850
Subfamily Caecinae Gray J.E., 1850
Genus *Caecum* Fleming, 1813

(type species *Dentalium trachea* Montagu, 1803 from England by subsequent designation, Gray J.E., 1847: p. 203)

Caecum Fleming, 1813: p. 67.

Brochus Brown, 1827: pl. 1.

Odontidium Philippi, 1836: p. 102, pl. 6, fig. 20.

Brochina Gray J.E., 1857: p. 101.

Pictocaecum Habe, 1978: p. 3, pl. 1, figs 14-17.

Caecum sepimentum de Folin, 1868
(Fig. 7E)

Caecum sepimentum de Folin, 1868b: p. 84, pl. 6, fig. 7.

? *Caecum gracile* Carpenter, 1858: p. 429.

Caecum sepimentum var. *arcuata* de Folin, 1880: p. 809.

Caecum lilianum Hedley, 1902: p. 603, pl. 29, fig. 7.

Caecum maculata [sic] Habe, 1963: p. 236, fig. 2.

Caecum berberense Ladd, 1972: p. 22, pl. 5, figs 11, 12.

Caecum sepimentum - Kay, 1979: p. 111, fig. 42B.

Caecum arcuatum - Kay, 1979: p. 111, fig. 42C.

Caecum septimentum [sic] - Lightfoot, 1992: p. 1, figs 2, 3.

Caecum gracile - Bandel, 1996: pl. 6, figs 5, 9.

Caecum gracile - Hasegawa, 2000: p. 171, pl. 85, fig. 1.

Caecum maculatum - Hasegawa, 2000: p. 171, pl. 85, fig. 2.

Caecum gracile - Sasaki, 2008: p. 169, fig. 9E, F.

Caecum sepimentum - Albano & Pizzini, 2011: p. 6, fig. 4A-D.

Caecum sepimentum - Pizzini et al., 2013: p. 5, figs 8A-D, F, G, 19K, 20A-D.

Caecum sepimentum - Ovalis & Mifsud, 2014: p. 3, figs 1, 2.

Caecum sepimentum - Vannozzi et al., 2015: p. 117, fig. 25D.

Type material

Lectotype MNHN-IM-2000-24907 selected by Pizzini et al. (2013: fig. 8D).

Type locality

Mauritius I.

Material examined.

The lectotype (ph) and:

PNG. Stn PB01, 1 sh; Stn PB04, 4 lv (2 juv); Stn PB06, 1 sh juv; Stn PB11, 1 sh; Stn PB13, 1 lv juv; Stn PB16, 2 lv; Stn PB19, 1 sh; Stn PB20, 2 sh (1 juv); Stn PB22, 2 lv + 2 sh juv; Stn PB24, 1 sh; Stn PB29, 1 sh; Stn PB30, 10 sh (4 juv); Stn PB31, 11 sh (5 juv); Stn PB32, 8 sh; Stn PB34, 1 lv; Stn PB35, 2 lv; Stn PB40, 3 lv; Stn PB45 4 lv + 1 sh; Stn PB49, 1 lv; Stn PB51, 2 lv; Stn PD06, 2 sh (1 juv); Stn PD10, 10 sh (1 juv, 3 fragm); Stn PD27, 11 sh (1 juv); Stn PD48, 1 sh; Stn PD66, 2 sh; Stn PM27, 1 sh juv; Stn PS08, 1 sh; Stn PS12, 2 sh; Stn PS31, 2 sh (1 juv); Stn PS38, 6 sh (3 juv); Stn PS40, 8 sh (2 juv); Stn PS41, 1 sh; Stn PS47, 1 sh; Stn KB02, 2 lv (1 juv) + 7 sh; Stn KB06, 3 sh; Stn KB08, 1 lv; Stn KB14, 1 lv; Stn KB18, 3 lv; Stn KB20, 1 lv + 1 sh; Stn KB22, 1 lv + 1 sh juv; Stn KB26, 27 sh (6 juv); Stn KB28, 12 sh (3 juv); Stn KB30, 2 lv; Stn KB34, 8 lv (3

juv); Stn KB36, 1 lv + 1 sh; Stn KB38, 12 lv + 2 sh; Stn KB40, 8 lv (2 juv); Stn KB42, 1 lv + 2 sh; Stn KB44, 2 sh; Stn KB46, 1 lv + 1 sh; Stn KB50, 35 sh (5 juv); Stn KB58, 1 sh; Stn KB60, 1 lv + 4 sh (1 juv); Stn KB62, 3 lv (1 juv); Stn KB70, 6 sh; Stn KD37, 15 lv (1 juv) + 1 sh; Stn KD38, 1 lv + 1 sh; Stn KD40, 1 sh; Stn KPR06, 4 sh; Stn KPR07, 1 sh; Stn KPS02, 9 sh; Stn KPS09, 2 sh; Stn KPS11, 7 sh (1 juv); Stn KPS12, 1 sh; Stn KPS13, 2 sh; Stn KPS17, 9 sh (1 juv); Stn KR186, 1 lv + 2 sh (1 juv); Stn KR57, 1 sh; Stn KS21, 1 lv; Stn KS27, 2 sh; Stn KS57, 1 sh; Stn KZ16, 1 sh; Stn KZ25, 4 lv (2 juv) + 1 sh.

Distribution

Eastern Africa (Red Sea to South Africa), Mascarene, Maldives, Indonesia, PNG, Philippines, Japan, Hawaii, French Polynesia, New Caledonia. Reported as allochthonous also from the Mediterranean Sea.

Diagnosis

Shell of average size for the genus. Tube subcylindrical, evenly arched. Sculpture of about 24 strong rings with subtriangular profile, appearing soon in the early teleoconch. Aperture preceded by a swelling, ending with some concentric small rings. Microsculpture of fine longitudinal threads. Septum almost flat without any appendage. Protoconch planispiral of about 1.75 whorls. Periostracum brownish. Colour white to creamy, often with darker blotches. Operculum with a terraced profile (Pizzini et al., 2013: fig. 19K). Adult shell length about 2.5 mm.

Remarks

Caecum gracile Carpenter, 1858 may be this species. However, the holotype shown by Johnson (1964: pl. 20, fig. 6) is worn and it is not possible to evaluate the key characters. Also, the original description and the unpublished Carpenter's drawing (pl. 70, fig. 23) may equally fit both *C. sepimentum* and *C. vertebrale*. Therefore, Carpenter's name is here treated as a *nomen dubium*.

For comparison among *C. sepimentum*, *C. vertebrale* and *C. oahuense*, see under *C. oahuense*.

Caecum vertebrale Hedley, 1899 (Fig. 7G)

Caecum vertebrale Hedley, 1899: p. 425, fig. 15.

? *Caecum multiannulatum* de Folin in Dautzenberg & Bouge, 1933: p. 354.

Caecum vertebrale - Kay, 1979: p. 111, fig. 42D.

Caecum vertebrale - Hasegawa, 2000: pl. 85, fig. 3.

Caecum gracile - Geiger et al., 2007: p. 3, fig. 1.

Caecum vertebrale - Hasegawa, 2000: p. 171, pl. 85, fig. 3.

Caecum vertebrale - Pizzini & Raines, 2011: p. 36, fig. 4J, K.

Caecum vertebrale - Pizzini et al., 2013: p. 8, fig. 8I, K-M.

Type material

Holotype AMS n. C5917.

Type locality

Tuvalu, Funafuti Atoll.

Material examined

The holotype (ph) and:

PNG. Stn PB50, 1 sh; Stn PD27, 1 sh; Stn PM27, 3 lv; Stn PS40, 1 sh; Stn PS47, 1 sh cf (fragm); Stn KB20, 1 sh; Stn KB26, 1 sh; Stn KB28, 2 sh (1 juv); Stn KB50, 9 sh; Stn KPS02, 1 sh; Stn KPS11, 2 sh (1 juv); Stn KR186, 1 sh; Stn KZ16, 1 sh.

Distribution

Japan, Philippines, PNG, New Caledonia, Loyalty, Vanuatu, Society.

Diagnosis

Shell of average size for the genus. Tube cylindrical, evenly arched. Sculpture of about 26 strong, rounded rings. Aperture simple, edged by two paired rings. Tube colourless, semitransparent. Septum dome-shaped without mucro, sometimes encrusted. Adult shell length about 2.5 mm.

Soft parts: head-foot colourless, semitransparent, showing few faint speckles on the neck.

Remarks

For comparison among *C. sepimentum*, *C. vertebrale* and *C. oahuense*, see under *C. oahuense*.

Caecum oahuense Pilsbry, 1921 (Fig. 7C)

Caecum oahuense Pilsbry, 1921: p. 375.

Caecum oahuense - Pizzini & Raines, 2011: p. 28, fig. 2I-P.

Type material

Lectotype ANSP 127978 selected by Pizzini & Raines (2011: fig. 2I).

Type locality

Hawaii, Oahu I.

Material examined

The lectotype (ph) and:

PNG. Stn PB16, 1 lv; Stn KB02, 1 sh; Stn KB44, 2 sh (1 gs); Stn KR57, 1 sh.

Distribution

Hawaii, Marquesas, Midway, PNG.

Diagnosis

Shell of average size for the genus. Tube cylindrical,

evenly arched. Sculpture of about 32 rounded rings. Aperture simple showing a slight swelling. Tube whitish, semitransparent. Septum dome-shaped without mucro, sometimes encrusted. Adult shell length about 2.5 mm.

Soft parts: head-foot colourless, semitransparent, showing few speckles on the neck grouped far from the eyes.

Remarks

C. sepimentum, *C. vertebrale* and *C. oahuense* are rather similar at first sight and may be confused one another. *C. sepimentum* is more subcylindrical and arched with sharp rings and shows an almost flat septum not reaching the cutting plane. On the other hand, *C. vertebrale* and *C. oahuense* are more cylindrical with visible, sometimes encrusted septum. Further, in *C. vertebrale* the septum is proportionally narrower than in *C. oahuense*. The number of rings is almost the same in *C. sepimentum* and *C. vertebrale*, while in *C. oahuense* the rings are more numerous. Both *C. sepimentum* and *C. oahuense* show a swelling close to the aperture, while in *C. vertebrale* the tube shows no variation in width close to the aperture. Finally, *C. sepimentum* shows often a colour pattern of brownish blotches, whereas the other two are uniformly semitransparent white. Moreover, *C. sepimentum* is by far more common than the other two species.

C. amydroglyptum Rehder, 1980 from Easter I., considered synonym of *C. oahuense* by Pizzini & Raines (2011), likely represents a distinct species.

Caecum smriglioi

Pizzini, Nofroni & Bonfitto, 2008

Caecum smriglioi Pizzini, Nofroni & Bonfitto, 2008: p. 23, fig. 2A-C.

Caecum smriglioi - Pizzini et al., 2013: p. 11, fig. 9D-F.

Type material

Holotype MZB60232.

Type locality

Srî-Lanka, Hikkaduwa, SW coast.

Material examined

The holotype (ph) and:

PNG. Stn PB01, 1 sh; Stn PB17, 1 sh; Stn PS22, 2 sh; Stn PS30, 1 sh; Stn PS31, 5 sh (2 gs); Stn PS43, 1 sh; Stn PS44, 1 sh; Stn PS45, 1 sh.

Distribution

Srî-Lanka, Philippines, PNG, New Caledonia, Vanuatu.

Diagnosis

Shell large for the genus. Tube slender, sculptured by

about 23 sharp rings. Aperture preceded by a clear swelling. Septum dome shaped, slightly protruding with a small, conical, blunt mucro directed to the dorsal side. Adult shell length about 3.5 mm.

Remarks

This species may at first sight be confused with *C. sepimentum* due to the slender tube and the sculpture of sharp rings. However, the presence of a small pointed, sharp mucro, completely lacking in *C. sepimentum*, permits to rule out any uncertainty.

Caecum clarum Lamy, 1909 ex de Folin MS

Caecum clarum Lamy, 1909 ex de Folin MS: 317, 318, pl. 15, fig. 9.

Caecum ruggerii Pizzini, 1997: p. 23, figs 1-3.

Caecum clarum - Pizzini et al., 2008: fig. 2F.

Type material

55 syntypes MNHN-IM-2000-24919 and MNHN-IM-2000-24920 (not seen).

Type locality

Madagascar, Nosy Be.

Material examined

PNG. Stn PD03, 1 sh; Stn PD31, 1 sh.

Additional material examined

Red Sea, 2 sh MSNIT n. 4393 (labelled as *Caecum annulatum* Brown).

Distribution

Eastern Africa (Red Sea, Madagascar) to Philippines, PNG, New Caledonia and Australia.

Diagnosis

Shell of average size for the genus. Tube subcylindrical, tapering toward the apex. Sculpture of about 28 rings, separated by equally wide interspaces. Aperture simple. Septum protruding, with a strong, blunt mucro directed to the right side, giving a subtriangular outline. Adult shell length about 2.7 mm.

Remarks

Only a couple of specimens of this species occurred in the available material. This species may recall both *C. smriglioi* and *C. varanoi* Pizzini, Nofroni & Bonfitto, 2008. However, *C. smriglioi* is more slender and shows a dorsal, pointed mucro, while *C. varanoi*, not found in the available material from PNG, can be distinguished

by the different shape of the tube and by the presence of a peculiar, lateral mucro with concave profile.

***Caecum neocaledonicum* de Folin, 1868**
(Fig. 7B)

- Caecum neo-caledonicum* de Folin, 1868a: p. 57, pl. 6, figs 1, 2.
Caecum fulvum Kisch, 1959: p. 17, fig. 1.
 †*Elephantanellum* sp. A Ladd, 1972: p. 23, pl. 5, fig. 15.
Caecum hinoidei Habe, 1978: p. 4, figs 11-13.
Caecum sp. cf. *glabella* Kay, 1979: p. 111, fig. 42G (non Carpenter in Adams, 1868).
Caecum neocaledonicum - Pizzini, 1998: p. 33, figs 1-7, 8-11, 12-17.
Caecum hinoidei - Hasegawa, 2000: p. 171, pl. 85, fig. 5.
Caecum neocaledonicum - Pizzini & Raines, 2011: p. 39, figs. 6B.
Caecum neocaledonicum - Pizzini et al., 2103: p. 13, figs 9G, H, J, K, 19H, 21A, B.

Type material

Lectotype MNHN-IM-2000-24909 selected by Pizzini (1998: fig. 5) and 22 paralectotypes MNHN-IM-2000-24910.

Type locality

New Caledonia, Nouméa.

Material examined

The lectotype (ph) and 1 paralectotype (ph) and: PNG. Stn PB20, 1sh juv; Stn PB22, 1 sh; Stn PB28, 1 lv juv; Stn PB34, 1 lv juv; Stn PB37, 1 lv juv + 1 sh; Stn PD72, 1 lv juv + 1 sh; Stn PM27, 4 lv (1 juv) + 3 sh (2 juv); Stn PS17, 1 sh; Stn PS32, 1 lv; Stn KB26, 1 lv + 3 sh; Stn KB38, 1 lv juv + 1 sh juv; Stn KB70, 1 sh juv; Stn KPD05, 1 sh; Stn KPS02, 1 sh; Stn KS45, 1 sh; Stn KZ25, 1 lv juv.

Distribution

IWP, from the eastern coast of Africa to Japan and French Polynesia.

Diagnosis

Shell large for the genus. Tube white, solid but not very thick. Sculpture of few strong rings close to the aperture. Septum protruding, dome-shaped with a clear marginal mucro rotated toward the right side. Microsculpture showing conspicuous wavy longitudinal cordlets. Adult shell length about 4 mm.

Soft parts: head-foot colourless, semitransparent, showing two semicircular spots of speckles above the eyes.

Remarks

This species is widespread in the whole tropical IWP, but never abundant. It can be easily distinguished by

the large size and by the presence of a clear longitudinal microsculpture covering the whole tube.

***Caecum nasutum* n. sp.**
(Fig. 1A-N)

Type material

Holotype (sh) MNHN-IM-2000-34752 from type locality; 1 paratype (sh) MNHN-IM-2000-34753 from Stn PB50; 3 paratypes (sh) MNHN-IM-2000-34754 from Stn PD31; 1 paratype (sh) MNHN-IM-2000-34755 from Stn PD66.

Type locality

Stn PS47: N Sek I., 05°04.7'S, 145°48.9'E, depth 8 m.

Material examined

The type material.

Distribution

North-East PNG.

Etymology

Derived from the Latin adjective *nasutus* due to the septum resembling a big nose. The name was suggested by the late Mauro Pizzini, who first recognized it as a new species.

Description

Shell of average size for the genus. Tube stout, solid, whitish, cylindrical, tapering toward the apex. Sculpture of fine sharp rings visible only in the abapical part. Aperture simple, slightly contracted, ending with a reflected lip. Septum large, protruding with a strong ear-like dorsal mucro, on the whole similar to a big nose in profile. Microsculpture of fine longitudinal striae interrupted by growth lines. Early stages, operculum and soft parts unknown. Measurements of the holotype: length 2.45 mm, max diam 0.57 mm, min diam 0.44 mm.

Remarks

The new species is characterized by a clearly subcylindrical adapical portion of the tube, the abapical portion covered with fine, regular annulations and the swollen septum with a very strong, almost dorsal mucro. *C. nasutum* can be compared with *C. inflatum* de Folin, 1869 and *C. varanoi*. *C. inflatum* is shorter and shows a more protruding septum. On the contrary, *C. varanoi* is larger and shows a sculpture of strong, sharp rings at least at the extremities of the tube. Furthermore, the mucro is rather different.

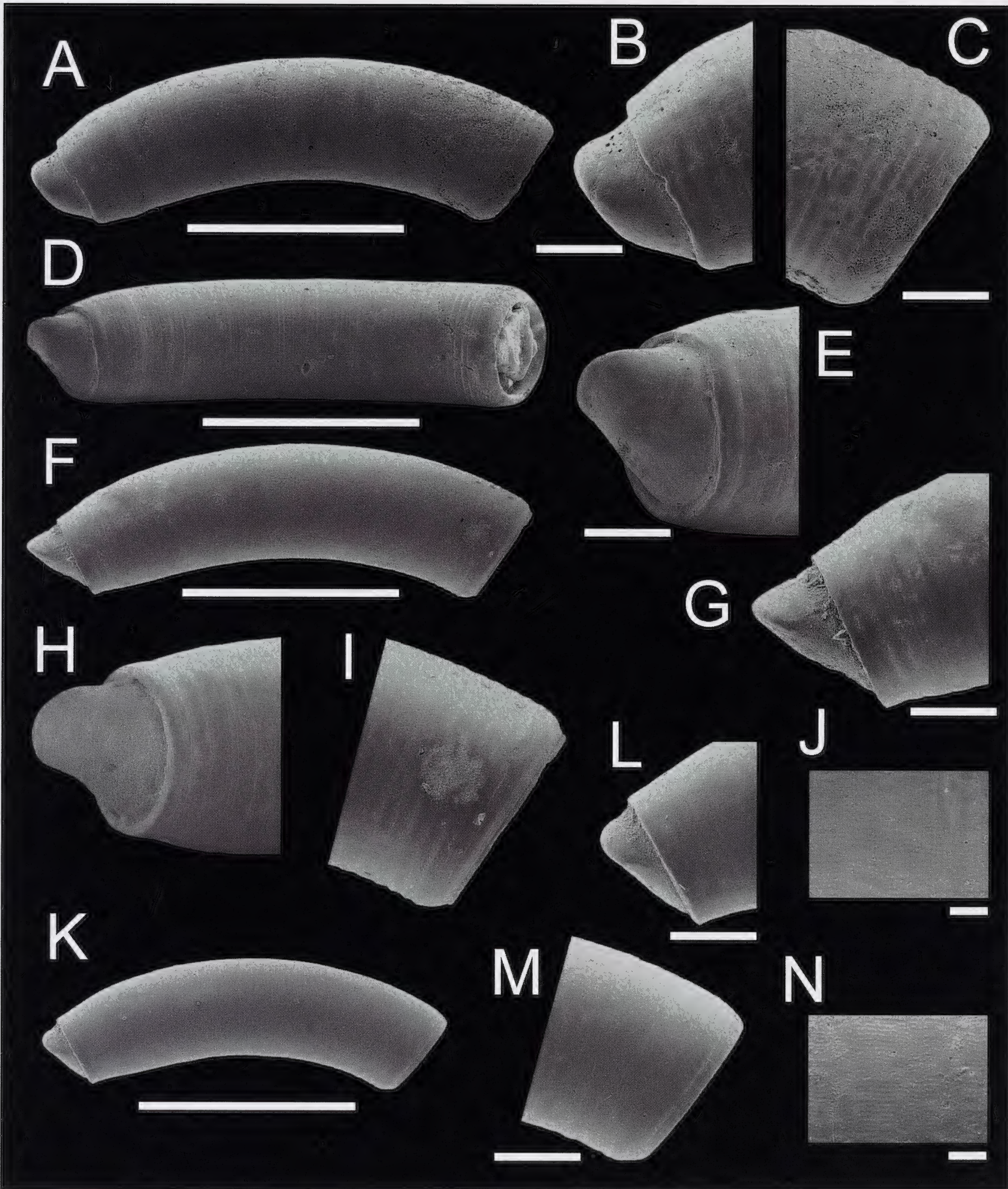


Fig. 1. A-N. *Caecum nasutum* n. sp.; **A-E.** holotype MNHN-IM-2000-34752, Stn PS47; **A.** side view; **B.** septum; **C.** aperture; **D.** ventral view; **E.** septum in ventral view; **F-J.** paratype MNHN-IM-2000-34754, Stn PD31; **F.** side view; **G.** septum; **H.** septum in ventral view; **I.** aperture; **J.** microsculpture; **K-N.** paratype MNHN-IM-2000-34754, Stn PD31; **K.** side view; **L.** septum; **M.** aperture; **N.** microsculpture. Scale bars: 1 mm (A, D, F, K); 200 μ m (B, C, E, G-I, L, M); 20 μ m (J, N).

Fig. 1. A-N. *Caecum nasutum* n. sp.; **A-E.** olotipo MNHN-IM-2000-34752, Stn PS47; **A.** vista laterale; **B.** setto; **C.** apertura; **D.** vista ventrale; **E.** setto in vista ventrale; **F-J.** paratipo MNHN-IM-2000-34754, Stn PD31; **F.** vista laterale; **G.** setto; **H.** setto in vista ventrale; **I.** apertura; **J.** microscultura; **K-N.** paratipo MNHN-IM-2000-34754, Stn PD31; **K.** vista laterale; **L.** setto; **M.** apertura; **N.** microscultura. Scala 1 mm (A, D, F, K); 200 μ m (B, C, E, G-I, L, M); 20 μ m (J, N).

Caecum cooki Pizzini & Raines, 2011

Caecum cooki Pizzini & Raines, 2011: p. 29, fig. 4A, B.
Caecum cooki - Pizzini et al., 2013: p. 35, fig. 14H-J.

Type material

Holotype MNHN-IM-2000-23124 and 1 paratype MNHN-IM-2000-23125.

Type locality

Tuamotu Arch., Makemo I., Arikitamiro Passage.

Material examined

The holotype (ph) and:

PNG. Stn KB34, 1 sh; Stn KD60, 1 sh cf; Stn KPS11, 1 sh; Stn KPS12, 1 sh.

Distribution

Society, Tuamotu, Philippines, PNG, Indonesia, Western Samoa, Mariana.

Diagnosis

Shell of average size for the genus. Tube smooth, tapering toward the apex. Aperture simple, preceded by a slight but clear swelling. Microsculpture of fine longitudinal striae interrupted by growth lines. Septum protruding, with a strong, ear-like mucro rotated toward the right side. Macula small, heart-shaped, white. Adult shell length about 2 mm.

Remarks

C. cooki is an uncommon but widespread species. It is rather similar to *C. modestum* as to the general aspect. However, *C. cooki* shows a clear swelling of the tube close to the aperture and a different periostracum, which shows a worm-like microsculpture instead of being covered with small granules. Furthermore, it shows a heart-shaped macula in the ventral side of the tube, never observed in *C. modestum*.

Caecum modestum de Folin, 1868 (Fig. 7F)

Caecum modestum de Folin, 1868a: p. 57, fig. 2.

Caecum malleatum de Folin, 1868a: p. 58, fig. 3.

Caecum modestum - Pizzini et al., 2013: p. 34, figs 14C-F, 19E, 21C-E.

Caecum modestum - Vannozzi, 2017: p. 127, fig. 2A-F.

Type material

Lectotype MNHN-IM-2000-24913 selected by Pizzini et al. (2013: fig. 14J) and 12 paralectotypes MNHN-IM-2000-24914.

Type locality

New Caledonia, Nouméa.

Material examined

The lectotype (ph) and:

PNG. Stn PB05, 4 lv + 4 sh (3 juv); Stn PB16, 2 lv; Stn PB19, 14 lv + 1 sh; Stn PB22, 5 sh; Stn PB24, 1 lv + 2 sh (1 juv); Stn PB28, 1 sh; Stn PB45, 2 lv; Stn PB46, 3 lv (1

juv) + 5 sh; Stn PB48, 2 sh; Stn PB52, 1 sh; Stn PB53, 1 sh; Stn PD03, 6 sh; Stn PD04, 2 sh; Stn PD06, 15 sh; Stn PD07, 1 sh; Stn PD14, 2 sh; Stn PD25, 5 sh; Stn PD27, 1 lv; Stn PD31, 1 lv; Stn PD35, 1 sh; Stn PD48, 2 sh (1 juv); Stn PD56, 1 sh juv; Stn PS03, 14 sh; Stn PS05, 5 sh; Stn PS06, 1 lv + 2 sh (1 juv); Stn PS12, 1 sh juv; Stn PS17, 3 sh; Stn PS21, 1 sh; Stn PS46, 7 sh; Stn KB06, 37 lv + 13 sh (3 juv); Stn KB12, 1 lv juv; Stn KB18, 8 lv (1 juv) + 10 sh (4 juv); Stn KB26, 1 sh; Stn KB42, 5 lv; Stn KB46, 1 lv; Stn KB50, 2 sh (1 juv); Stn KB54, 5 lv + 9 sh (2 juv); Stn KB58, 2 lv + 1 sh; Stn KD28, 4 lv (3 juv) + 57 sh (6 juv); Stn KD51, 1 sh; Stn KD56, 2 sh (1 juv); Stn KD60, 3 lv + 3 sh (1 juv); Stn KD61, 1 lv + 1 sh; Stn KD62, 3 lv + 1 sh; Stn KD65, 1 sh; Stn KD67, 3 sh; Stn KD85, 9 sh; Stn KD86, 1 lv + 6 sh (1 juv); Stn KM24, 1 lv juv; Stn KM28, 4 lv; Stn KS23, 2 sh juv; Stn KS27, 1 lv + 3 sh; Stn KS45, 1 sh; Stn KS53, 1 sh; Stn KS55, 1 lv + 1 sh; Stn KS59, 8 lv; Stn KZ16, 21 lv (2 juv) + 2 sh.

Distribution

New Caledonia, Vanuatu, Philippines, PNG.

Diagnosis

Shell of average size for the genus. Tube evenly arched, smooth. Aperture simple, slightly contracted, with a slight swelling in the ventral side. Septum protruding, convex, with a strong dorsal nail-like mucro. Periostracum sponge-like, covered with small granules. Granules are arranged in longitudinal rows in the early teleoconch, tending to be aligned according to the growth lines in the late teleoconch. Operculum with a spiral of about 6 whorls. Adult shell length about 2 mm.

Soft parts: head-foot whitish, semitransparent, showing a strip of crowded speckles on the neck, divided into two lobes just above the eyes, hardly touching them and extending shortly beyond.

Remarks

C. modestum is a very common species. As previously reported, this species is rather variable in terms of slenderness and size. However, *C. modestum* is easily recognized by the opaque aspect due to the periostracum covered with granules (Vannozzi, 2017: fig. 2F). Also in the case of PNG samples, the slender, twisted form is dominant. See also remarks under *C. cooki*.

Caecum egenum Vannozzi, 2017

Caecum egenum Vannozzi, 2017: p. 127, fig. 2G-J, N.

Type material

Holotype MNHN-IM-2000-33078.

Type locality

Philippines, Balicasag I.

Material examined

The holotype and:
PNG. Stn PB27, 1 sh; Stn PM27, 1 sh juv.

Distribution

Philippines, PNG.

Diagnosis

Shell small for the genus, colourless, smooth. Tube sub-cylindrical adapically, cylindrical in the middle and contracted toward the aperture, with a slight swelling in the ventral side. Aperture simple ending with a reflected lip. Septum dome-shaped with a broad and low ear-like mucro rotated toward the right side. Surface smooth with faint wavy shallow grooves due to the imprint of the periostracum. Periostracum yellowish, dull, showing a regular longitudinal worm-like microsculpture. Operculum with a spiral of $5\frac{3}{4}$ whorls. Juvenile similar to adult stage, but more slender and arched, aperture simple. Adult shell length about 1.6 mm.

Remarks

C. egenum may be difficult to identify due to the lack of clear-cut diagnostic characters. The smooth tube, the dome-shaped septum with very low mucro and the contracted aperture permit to recognize this species. The most similar species are *C. modestum* and *C. gulosum*. However, *C. modestum* shows a stronger dorsal mucro and a different periostracum covered with granules, whereas in *C. egenum* it shows a worm-like microsculpture. On the other hand, *C. gulosum* is more slender and shows a sculpture of very fine rings and a swelling before the aperture.

***Caecum nofronii* n. sp.**
(Fig. 2A-N)

Type material

Holotype (sh) MNHN-IM-2000-34756 from type locality; 1 paratype (sh) MNHN-IM-2000-34757 from Stn KB50; 1 paratype (sh) MNHN-IM-2000-34758 from Stn PB38; 1 paratype (sh) from Thailand, Freedom, Phuket I., depth 3 m, leg. I. Nofroni iv.1995 (IN).

Type locality

Stn KB22: Kavieng Lagoon, 02°45.2'S, 150°43.1'E, depth 8-24 m.

Material examined

The type material and:
PNG. Stn KB20, 1 lv (drilled); Indonesia. Unspecified locality, 4 sh (1 gs) (IP).

Distribution

PNG, Thailand, Indonesia.

Etymology

Dedicated to Italo Nofroni (Rome, Italy) for his contribution to malacology and to the knowledge of the family Caecidae in particular.

Description

Shell of average size for the genus. Tube slender, cylindrical, tapering toward the apex. Sculpture of fine rings narrower than the interspaces, best visible toward the aperture. Aperture hardly inclined, preceded by a clear swelling, then contracted and ending with a reflected lip. Shallow longitudinal grooves occasionally present. Microsculpture of fine longitudinal grooves. Periostracum colourless to yellowish showing a longitudinal, worm-like microsculpture. Septum low dome-shaped, encrusted, with a very small finger-like mucro. Early stage similar to adult one but more slender, aperture similar but less developed than in the adult stage. Protoconch, operculum and soft parts unknown. Measurements of the holotype: length 2.3 mm, max diam 0.48 mm, min diam 0.34 mm.

Remarks

C. nofronii may be confused with *C. gulosum* Hedley, 1899, which shares the dome-shaped septum, the slender tube with fine rings and the swelling before the aperture. However *C. nofronii* shows a very small, finger-like mucro, sometimes hardly distinct from the granules covering the septum, while in *C. gulosum* the mucro is very low and broad (Vannozzi, 2017: fig. 2K, L) and sometimes concealed under the cutting plane (Pizzini et al., 2013: fig. 11H). Noteworthy, Hedley's species was not found in the examined material.

***Caecum granulatum* n. sp.**
(Fig. 2O-U)

Type material

Holotype (sh) MNHN-IM-2000-34759 and 3 paratypes (sh) MNHN-IM-2000-34760 from type locality; 1 paratype (sh juv) MNHN-IM-2000-34761 from Stn KD28; 1 paratype (lv) MNHN-IM-2000-34762 from Stn KD56.

Type locality

Stn KD51: Kavieng Lagoon, 02°40.9'S, 150°52.1'E, depth 1-2 m.

Material examined

The type material and:
Central Philippines. Panglao I., depth 3 m, 1 sh.

Distribution

Philippines, PNG.

Etymology

Derived from the Latin adjective *granulatus* (granulated) due to the roughened aspect of the septum.

Description

Shell of average size for the genus. Tube rather stout, cylindrical. Sculpture of fine, low rings and irregular longitudinal grooves. Aperture slightly inclined, preceded by a very low, flat and tapering varix crossed by the rings, ending with a hardly reflected lip. Microsculpture of broad longitudinal threads. Periostracum light tan, easily lost, sponge-like. Septum low dome-shaped, granulated, showing a broad and very low mucro just above the cutting plane, rotated toward the right side. Early stage similar to adult one including the apertural varix, but smaller and more slender. Larval stage operculum and soft parts unknown. Measurements of the holotype: length 2.2 mm, max diam 0.5 mm, min diam 0.42 mm.

Remarks

C. granulatum may be confused with both *C. gulosum* and *C. nofronii*. However, *C. gulosum* is slender and shows an almost hemispherical, smooth septum, whereas in *C. granulatum* the tube is larger and proportionally wider and the septum is lower and covered by granules. Also the periostracum is different, showing in *C. gulosum* a worm-like microsculpture which is absent in *C. granulatum*. On the other hand, *C. nofronii* can be mainly distinguished by the presence of a very small, finger-like mucro, whereas in *C. granulatum* the mucro is flat and hardly emerging from the cutting plane.

Caecum frugi n. sp. (Fig. 2V-Y)

Type material

Holotype (sh) MNHN-IM-2000-34763 from type locality.

Type locality

Stn KB02: Kavieng Lagoon, 02°35.2'S, 150°46.2'E, depth 6 m.

Material examined

The holotype.

Distribution

Known only from the type locality.

Etymology

Derived from the Latin adjective *frugi* (frugal) due to its reduced size with respect, and in opposition, to *C. gulosum* (gourmand), the most similar species.

Description

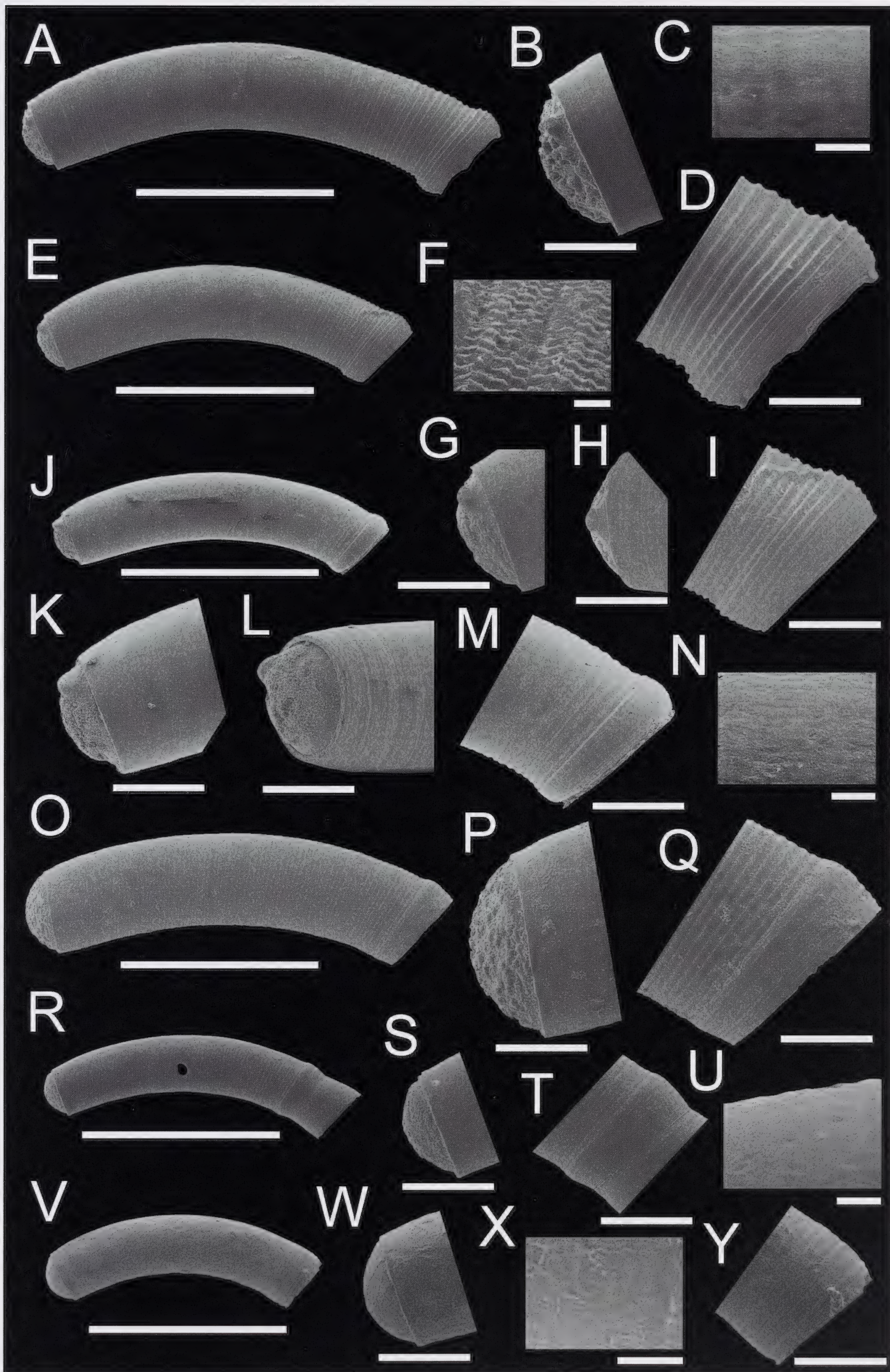
Shell small for the genus. Tube slender, cylindrical, smooth apart from some wide, flat rings visible in the adapical part. Rings appear to be formed, at high magnification, by groups of 6-7 small rings separated by equally wide interspaces. Tube slightly swollen before the aperture, which is simple, not inclined and ending with a reflected lip. Septum dome-shaped, almost hemispherical, showing a very low mucro between the dorsal and the right side, hardly emerging above the cutting plane. Periostracum opaque, covered by longitudinal rows of granules of around 1 µm in diameter. Early stages, operculum and soft parts unknown. Measurements of the holotype: length 1.43 mm, max diam 0.32 mm, min diam 0.27 mm.

Remarks

C. frugi strongly resembles *C. gulosum* due to the general appearance and can be easily confused with it. The main distinctive characters are the microsculpture of the periostracum, worm-like in *C. gulosum*, composed of aligned granules in *C. frugi*, and by the sculpture of the abapical part of the tube. In fact, while *C. gulosum* shows very fine, sharp rings close to the aperture and extending to the swelling, *C. frugi* shows broad, almost flat rings and hardly visible swelling.

Fig. 2. A-N. *Caecum nofronii* n. sp.; **A-D.** holotype MNHN-IM-2000-34756, Stn KB22; **A.** side view; **B.** septum; **C.** microsculpture; **D.** aperture; **E-I.** paratype MNHN-IM-2000-34757, Stn KB50; **E.** side view; **F.** microsculpture of the periostracum; **G.** septum; **H.** detail of the mucro; **I.** aperture; **J-N.** paratype MNHN-IM-2000-34758, Stn PB38; **J.** side view; **K.** septum; **L.** septum in ventral view; **M.** aperture; **N.** microsculpture. **O-U.** *Caecum granulatum* n. sp.; **O-Q.** holotype MNHN-IM-2000-34759, Stn KD51; **O.** side view; **P.** septum; **Q.** aperture; **R-U.** paratype (growth stage) MNHN-IM-2000-34761, Stn KD28; **R.** side view; **S.** septum; **T.** former aperture; **U.** microsculpture. **V-Y.** *Caecum frugi*, holotype MNHN-IM-2000-34763, Stn KB02; **V.** side view; **W.** septum; **X.** microsculpture; **Y.** aperture. Scale bars: 1 mm (A, E, J, O, R, V); 200 µm (B, D, G-M, P, Q, S, T, W, Y); 50 µm (C, X); 20 µm (N, U); 10 µm (F).

Fig. 2. A-N. *Caecum nofronii* n. sp.; **A-D.** olotipo MNHN-IM-2000-34756, Stn KB22; **A.** vista laterale; **B.** setto; **C.** microscultura; **D.** apertura; **E-I.** paratipo MNHN-IM-2000-34757, Stn KB50; **E.** vista laterale; **F.** microscultura del periostraco; **G.** setto; **H.** dettaglio del mucro; **I.** apertura; **J-N.** paratipo MNHN-IM-2000-34758, Stn PB38; **J.** vista laterale; **K.** setto; **L.** setto in vista ventrale; **M.** apertura; **N.** microscultura. **O-U.** *Caecum granulatum* n. sp.; **O-Q.** olotipo MNHN-IM-2000-34759, Stn KD51; **O.** vista laterale; **P.** setto; **Q.** apertura; **R-U.** paratipo (stadio di crescita) MNHN-IM-2000-34761, Stn KD28; **R.** vista laterale; **S.** setto; **T.** apertura precedente; **U.** microscultura. **V-Y.** *Caecum frugi*, olotipo MNHN-IM-2000-34763, Stn KB02; **V.** vista laterale; **W.** setto; **X.** microscultura; **Y.** apertura. Scala: 1 mm (A, E, J, O, R, V); 200 µm (B, D, G-M, P, Q, S, T, W, Y); 50 µm (C, X); 20 µm (N, U); 10 µm (F).



Caecum kontiki Pizzini & Raines, 2011
(Fig. 3A-E)

Caecum kontiki Pizzini & Raines, 2011: p. 28, fig. 2G, H.
Caecum kontiki - Pizzini et al., 2013: p. 24, fig. 11L, M.

Type material

Holotype MNHN-IM-2000-22068.

Material examined

The holotype and:
PNG. Stn PB29, 1 sh.

Distribution

Society, Loyalty, PNG.

Diagnosis

Shell of average size for the genus, smooth, semitransparent. Tube slender, cylindrical, tapering toward the apex. Tube smooth apart from hardly visible rings on the adapical part. Aperture preceded by a strong rounded varix crossed by fine irregular rings and ending with a reflected lip. Microsculpture of fine longitudinal grooves. Septum dome shaped with an indistinct mucro positioned between the dorsal and the right side. Adult shell length about 2.8 mm.

Remarks

C. kontiki is a very rare species, so far known from a very limited number of specimens. The shell shown in Fig. 3A-C agrees with the holotype of *C. kontiki* as far as the microsculpture of the shell and the apertural varix are concerned, but is more subcylindrical adapically and less slender. However, when comparing the shape of the mucro of the specimen from PNG with the one of the holotype (Fig. 3E), not visible in the original figure, no differences can be detected. Therefore, I regard this specimen as falling within the variability of *C. kontiki*.

Caecum prae grande Vannozzi, 2017
(Fig. 3F-J)

Caecum prae grande Vannozzi, 2017: p. 129, 130, fig. 2O-Q.

Type material

Holotype MNHN-IM-2000-33079.

Type locality

Philippines, Panglao I.

Material examined

The holotype and:
PNG. Stn PS43, 1 sh.

Distribution

Philippines, PNG.

Diagnosis

Shell very large for the genus, smooth. Tube stout, cylindrical, inflated adapically and tapering toward the apex. Surface smooth. Microsculpture longitudinal worm-like, hardly visible. Aperture slightly inclined surrounded by a strong varix, contracted and crossed by irregular rings. Septum low dome-shaped with a very small dorsal mucro. Adult shell length 3.7 to 5.3 mm.

Remarks

This species is easily distinguished by its very large size. Although strongly resembling *C. loyaltense* due to the large size and general appearance, the different shape of the apertural varix, the inflated adapical part and the presence of a very small dorsal mucro in *C. prae grande* justify the separation of the two species.

Caecum directum n. sp.
(Fig. 4A-F)

Type material

Holotype (sh) MNHN-IM-2000-34764 from type locality and 1 paratype (sh) MNHN-IM-2000-34765 from Stn KB26.

Type locality

Stn PD10: W Kranket I., 05°11.7'S, 145°48.8'E, depth 16-28 m.

Material examined

The type material and:
PNG. Stn PS40, 1 sh *C. cf. directum* (gs); 1 sh (ph), Kavieng, 2012 (IK).

Distribution

Northern PNG.

Etymology

Derived from the Latin adjective *directus* (straight) due to the low curvature of the tube.

Description

Shell of average size for the genus, colourless, semitransparent. Tube cylindrical, slender, slightly arched, subcylindrical close to the apex, with very fine regular rings, best visible toward the aperture. Tube slightly contorted in ventral view. Aperture inclined toward both the ventral and the left side, surrounded by a large



Fig. 3. A-E. *Caecum kontiki*; **A-C.** Stn PB29; **A.** side view; **B.** aperture; **C.** septum; **D, E.** holotype MNHN-IM-2000-22068 (**E.** image courtesy Manuel Caballer, MNHN). **F-J.** *Caecum praegrande*, Stn PS43; **F.** side view; **G.** microsculpture; **H.** septum; **I.** septum in ventral view; **J.** aperture. Scale bars: 1 mm (A, D, E, F); 200 μ m (B, C, H-J); 20 μ m (G).

Fig. 3. A-E. *Caecum kontiki*; **A-C.** Stn PB29; **A.** vista laterale; **B.** apertura; **C.** setto; **D, E.** olotipo MNHN-IM-2000-22068 (**E.** per gentile concessione di Manuel Caballer, MNHN). **F-J.** *Caecum praegrande*, Stn PS43; **F.** vista laterale; **G.** microscultura; **H.** septum; **I.** setto in vista ventrale; **J.** apertura. Scala: 1 mm (A, D, E, F); 200 μ m (B, C, H-J); 20 μ m (G).

swelling crossed by fine sharp rings, and ending with a reflected lip. Longitudinal shallow grooves can be detected. Microsculpture of fine regular longitudinal threads, surmounting the rings. Septum dome shaped, with a clear nail-like dorsal mucro as high as the septum. Early stages, operculum and soft parts unknown.

Measurements of the holotype: length 2.15 mm; max diam 0.45 mm; min diam 0.35 mm.

Remarks

A growth stage tentatively attributed to the new species

is shown in Fig. 4G-I. It shows a narrow young stage which gradually but rapidly expands to form the adult shell without any apparent transition. Although there is an almost perfect superposition with the holotype of *C. directum*, the growth stage lacks the longitudinal microsculpture, therefore its attribution is tentative.

C. directum is similar to *C. kontiki*. However, *C. directum* is smaller and shows a strong, nail-like dorsal septum. Moreover, in *C. directum* the tube is slightly contorted in ventral view and the aperture is inclined to the left side, whereas in *C. kontiki* there is no sign of twisting.

C. directum can be also compared with *C. subflavum* de Folin, 1880. This comparison is rather problematic though. In fact, the holotype of *C. subflavum* is a growth stage with the juvenile tube still attached, therefore the septum of the adult stage cannot be evaluated (Pizzini et al., 2013: fig. 12J). Comparing with the possible growth stage of *C. directum* shown in Fig. 4G-I, *C. subflavum* is more strongly arched and the juvenile shell shows a sculpture of coarse rings. Moreover, the shape of the varix in *C. subflavum* and *C. directum* is different. Additional material is necessary to clarify the identity of de Folin's species.

C. sp. 1 from the Central Philippines may be this species (Vannozzi, 2017: p. 130).

Caecum virginiae

Pizzini, Raines & Vannozzi, 2013

Caecum virginiae Pizzini, Raines & Vannozzi, 2013: p. 16, fig. 9L-N.

? *Caecum sp. B* Pizzini, Raines & Vannozzi, 2013: p. 39, fig. 14A.

Caecum virginiae - Vannozzi, 2017: p. 125, fig 2R, S.

Type material

Holotype MNHN-IM-2000-24833 and 1 paratype MNHN-IM-2000-24834.

Type locality

Fiji I., S of Viti Levu.

Material examined

The holotype (ph) and:
PNG. Stn PB31, 1 sh.

Distribution

Fiji, Philippines, PNG.

Diagnosis

Shell very small for the genus, evenly arched, with very fine and regular rings throughout the length of the tube. Aperture preceded by a clear ring-like swelling. Septum slightly protruding with a nail-like dorsal mucro. Adult shell length about 1.3 mm.

Remarks

C. virginiae is similar to *C. musorstomi*, but is easily identified due to its very small size.

Caecum inflatulum Vannozzi, 2017 (Fig. 7A)

Caecum inflatulum Vannozzi, 2017: p. 124, 130, fig. 1E-L.

Type material

Holotype MNHN-IM-2000-33074 and 9 paratypes (all MNHN).

Type locality

Philippines, Bohol I.

Material examined

The type material and:

PNG. Stn KB26, 1 sh; Stn KB46, 1 sh; Stn KD28, 4 sh; Stn KD60, 4 lv + 4 sh; Stn KPR06, 1 sh; Stn KS23, 1 sh; Stn KS53, 1 lv juv.

Distribution

Philippines and PNG.

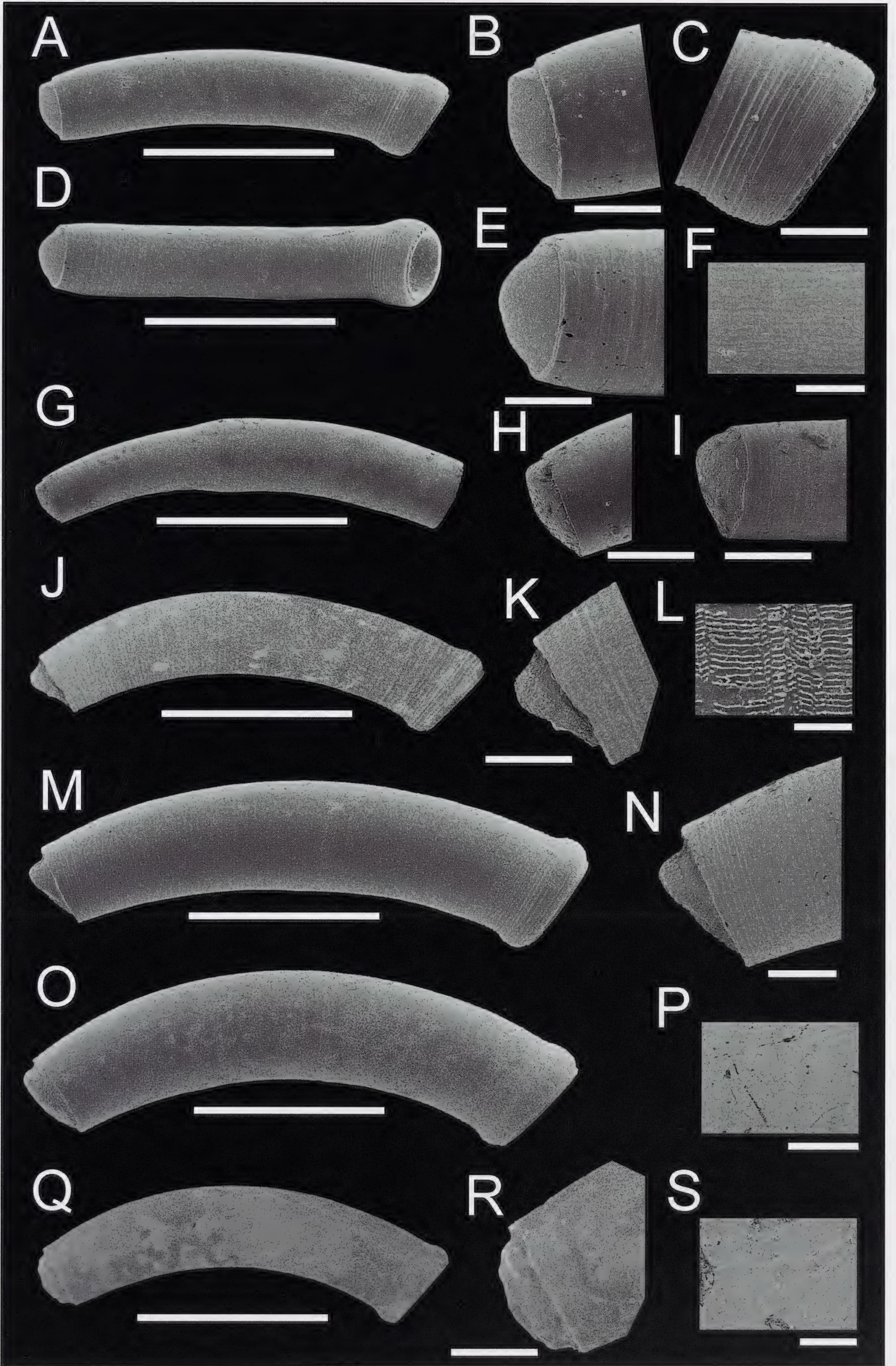
Diagnosis

Shell of average size for the genus, colourless, glossy. Tube slender, subcylindrical, slightly arched. Sculpture of rounded rings, sometimes obsolete, occasionally completely missing. Septum very protruding with a strong nail-like mucro. Aperture simple with only a slight swelling. Adult shell length about 2 mm.

Soft parts: head-foot colourless, semitransparent, showing a strip of crowded speckles on the neck, distantly divided into two narrowing branches ending far from the eyes.

Fig. 4. A-F. *Caecum directum* n. sp., holotype MNHN-IM-2000-34764, Stn PD10; **A.** side view; **B.** septum; **C.** aperture; **D.** ventral view; **E.** septum in ventral view; **F.** microsculpture. **G-I.** *Caecum cf. directum*, growth stage, Stn PS40; **G.** side view; **H.** septum; **I.** septum in ventral view. **J-N.** *Caecum musorstomi*; **J-L.** Stn PS08; **J.** side view; **K.** septum; **L.** microsculpture of the periostracum; **M, N.** Stn PD19; **M.** side view; **N.** septum. **O, P.** *Caecum cf. musorstomi*, Stn PS17; **O.** side view; **P.** microsculpture. **Q-S.** *Caecum sp. 2*, Stn PB04; **Q.** side view; **R.** septum; **S.** microsculpture. Scale bars: 1 mm (A, D, G, J, M, O, Q); 200 µm (B, C, E, H, I, K, N, R); 50 µm (P); 20 µm (F, L, S).

Fig. 4. A-F. *Caecum directum* n. sp., olotipo MNHN-IM-2000-34764, Stn PD10; **A.** vista laterale; **B.** setto; **C.** apertura; **D.** vista ventrale; **E.** setto in vista ventrale; **F.** microscultura. **G-I.** *Caecum cf. directum*, stadio di crescita, Stn PS40; **G.** vista laterale; **H.** setto; **I.** setto in vista ventrale. **J-N.** *Caecum musorstomi*; **J-L.** Stn PS08; **J.** vista laterale; **K.** setto; **L.** microscultura del periostraco; **M, N.** Stn PD19; **M.** vista laterale; **N.** setto. **O, P.** *Caecum cf. musorstomi*, Stn PS17; **O.** vista laterale; **P.** microscultura. **Q-S.** *Caecum sp. 2*, Stn PB04; **Q.** vista laterale; **R.** setto; **S.** microscultura. Scala: 1 mm (A, D, G, J, M, O, Q); 200 µm (B, C, E, H, I, K, N, R); 50 µm (P); 20 µm (F, L, S).



Remarks

C. inflatulum is a rather variable species, but can be easily identified by the protruding septum with strong, dorsal nail-like mucro and the simple aperture showing only a slight swelling.

Caecum musorstomi

Pizzini, Raines & Vannozzi, 2013

(Fig. 4J-N)

Caecum musorstomi Pizzini, Raines & Vannozzi, 2013: p. 27, figs 12G-I, 19F.

Caecum musorstomi - Vannozzi, 2017: p. 128, fig. 2T, V, W.

Type material

Holotype MNHN-IM-2000-24921 and several paratypes (all MNHN).

Type locality

New Caledonia, Nouméa Sector SW.

Material examined

The holotype (ph) and:

PNG. Stn PB04, 1 sh; Stn PB31; Stn PB46, 1 lv + 1 sh; Stn PB48, 2 sh; Stn PB51, 1 sh; Stn PD06, 7 sh; Stn PD10, 1 sh; Stn PD19, 1 sh; Stn PS08, 1 lv; Stn PS17, 1 sh; Stn KB18, 1 lv juv + 1 sh juv; Stn KB26, 1 lv + 3 sh; Stn KB36, 1 sh cf; Stn KB38, 1 lv + 2 sh; Stn KB50, 1 sh cf (no apex); Stn KB54, 2 sh; Stn KB70, 3 sh (1 juv); Stn KR186, 1 sh; Stn KS19, 2 sh.

Distribution

New Caledonia, Vanuatu, Philippines, PNG.

Diagnosis

Shell of average size for the genus. Tube slender, evenly arched. Sculpture of obsolete small rings, best visible toward the aperture. Aperture preceded by a well-developed swelling crossed by small rings. Longitudinal microsculpture present. Septum slightly protruding with a rounded mucro rotated toward the right side. Adult shell length about 2 mm.

Remarks

C. musorstomi is a widespread species and occurs rather frequently. It shows rather constant characters and normally it is not difficult to identify. In the material from PNG, unusually large specimens reaching 3 mm occasionally occurred (Fig. 4M, N). However, they show no differences with respect to normal specimens of *C. musorstomi* and have been identified accordingly.

Caecum sp. 2

(Fig. 4Q-S)

Material examined

PNG. Stn PB04, 1 sh (worn).

Distribution

So far known from a single specimen from PNG.

Description

Shell of average size for the genus, white, slightly eroded. Tube subcylindrical, arched, without sculpture. Aperture not inclined surrounded by a rounded varix, ending with a reflected lip. Microsculpture of fine longitudinal threads. Septum dome shaped, protruding, with a low, ear-like mucro oriented between the dorsal and the right side. Early stages, operculum and soft parts unknown. Length 2.15 mm.

Remarks

This specimen recalls *C. musorstomi*, because of the similar shape of the tube, the presence of a clear swelling before the aperture and the longitudinal microsculpture. However, *C. sp. 2* is less slender and shows a dome-shaped septum with an ear-like mucro rotated toward the right side. Additional material is necessary to establish if this specimen belongs to an undescribed species or if it represents an anomalous specimen of a known species.

Caecum succineum de Folin, 1880

Caecum succineum de Folin, 1880: p. 810.

Caecum succineum - de Folin, 1881: p. 25, pl. 2, figs 12, 13.

Caecum succineum - de Folin, 1886: p. 685, Caecidae pl. 3, figs 15, 16.

Caecum sp. a Bosch et al., 1995: p. 49, n. 144.

Caecum succineum - Pizzini et al., 2013: p. 25, figs 11Q, R, 12A-C.

Caecum succineum - Vannozzi et al., 2015: p. 10, fig. 25 G, H.

Type material.

Lectotype NHMUK 1887.2.9.2344 selected by Pizzini et al. (2013: fig. 11R) and some paralectotypes (all NHMUK).

Type locality

Australia, Queensland, Cape York, Flinders Passage.

Material examined

The type material (ph) and:

PNG. Stn PB10, 1 sh; Stn PB16, 1 lv; Stn PB46, 1 sh; Stn PD30, 1 sh; Stn PD66, 2 sh; Stn KD36, 1 lv.

Distribution

Eastern Africa to the South-West Pacific and PNG.

Diagnosis

Shell small for the genus. Tube evenly arched, smooth, showing some rings toward the aperture. Aperture preceded by a slight swelling. Septum low dome shaped without mucro, sometimes encrusted. Adult shell length about 1.6 mm.

Remarks

C. succineum is characterized by a combination of characters such as the small size, the low septum without mucro and the presence of some flat rings close to the aperture. In some cases, the tube is perfectly smooth and the septum is encrusted, but no other differences exist.

Caecum neoguineanum n. sp. (Fig. 5A-J)

Type material

Holotype (sh) MNHN-IM-2000-34766 and 1 paratype (sh) MNHN-IM-2000-34767 from type locality; 1 paratype (sh) MNHN-IM-2000-34768 from Stn PD10.

Type locality

Stn PS40: S Sek I., 05°07.0'S, 145°49.4'E, depth 17 m.

Material examined

The type material.

Distribution

Known only from the type locality and Kranket I. (Stn PB10).

Etymology

Derived from the region where this species was found.

Description

Shell of average size for the genus, whitish, slightly glossy. Tube cylindrical, slender, arched, smooth without sculpture, apart from obsolete, hardly visible longitudinal threads in the apical end. Tube slightly inflated before the aperture, which is simple, slightly contracted and inclined, lip not reflected, sharp. No clear microsculpture. Septum low dome shaped without mucro, not reaching the cutting plane. Early stages, operculum and soft parts unknown. Measurements of the holotype: length 2.4 mm; max diam 0.45 mm; min diam 0.35 mm.

Remarks

The new species is characterized by a smooth tube with a low-dome shaped not reaching the cutting plane. In

both the holotype and the paratype from type locality, clear signs of temporary septum (see Pizzini et al., 1998) can be detected (Fig. 5C, I). The part of tube between the septum and the cutting plane is visible by optical microscopy as an opaque white narrow band. *C. neoguineanum* recalls *C. japonicum* because of the general appearance and the type of septum. However, *C. neoguineanum* is white and shows a more slender and cylindrical tube. *C. neoguineanum* can also be compared with *C. subcylindratum* Pizzini, Raines and Vannozzi, 2013 from Vanuatu. However, the latter is smaller and differs by the subcylindrical shape of tube and by the aperture with thick, blunt lip.

Caecum japonicum (Habe, 1978) (Figs 5K-M, 7D)

Pictocaecum japonicum Habe, 1978: p. 3, pl. 1, figs 14-17.

Caecum (*Pictocaecum*) *japonicum* - Hasegawa, 2000: p. 173, pl. 86, fig. 7.

Caecum japonicum - Pizzini et al., 2013: p. 26, figs 12D-F, 19D, 20K-P, 21E.

Type material

Holotype NSMT Mo 55371 and paratype NSMT Mo 55372 (both NMNS).

Type locality

Japan, Kyushu, Matsugaura, Chiran-cho on the coast of Kagoshima Bay.

Material examined

The type material (ph) and:

PNG. Stn PB04, 4 lv; Stn PB06, 1 lv juv + 1 sh; Stn PB10, 30 lv; Stn PB13, 6 lv (1 juv); Stn PB14, 3 lv; Stn PB17, 2 lv; Stn PB18, 1 sh; Stn PB19, 24 lv (1 juv); Stn PB20, 1 lv + 2 sh; Stn PB22, 10 lv (1 juv, 1 larv) + 3 sh (1 juv); Stn PB24, 3 lv + 1 sh; Stn PB27, 1 sh; Stn PB29, 2 lv; Stn PB30, 8 lv (1 juv) + 1 sh; Stn PB31, 3 lv + 3 sh; Stn PB32, 1 sh juv; Stn PB35, 9 lv; Stn PB37, 6 lv; Stn PB39, 1 lv; Stn PB45, 3 lv + 3 sh (1 juv); Stn PB46, 13 lv (2 juv); Stn PB47, 1 sh juv; Stn PB50, 1 sh; Stn PD03, 14 lv (1 juv); Stn PD10, 4 sh; Stn PD18, 5 sh; Stn PD25, 3 sh; Stn PD27, 2 lv (1 juv) + 1 sh juv; Stn PD56, 1 sh; Stn PD66, 1 sh; Stn KB02, 2 lv; Stn KB06, 42 lv (8 juv) + 119 sh (13 juv); Stn KB12, 9 lv; Stn KB16, 5 lv (1 juv) + 1 sh juv; Stn KB18, 59 lv (13 juv) + 34 sh (2 juv); Stn KB20, 1 sh; Stn KB22, 10 lv (1 juv) + 3 sh; Stn KB26, 3 lv + 28 sh (1 juv, 1 larv); Stn KB28, 11 lv (1 juv) + 16 sh (2 juv); Stn KB30, 6 lv (3 juv); Stn KB36, 120 lv (29 juv) + 2 sh (1 larv); Stn KB38, 53 lv (7 juv); Stn KB40, 57 lv (6 juv); Stn KB42, 31 lv (5 juv) + 5 sh; Stn KB44, 4 lv + 3 sh (1 juv); Stn KB46, 105 lv (5 juv); Stn KB54, 1 sh (worn); Stn KB56, 1 sh juv; Stn KB58, 17 lv (3 juv) + 3 sh; Stn KB62, 50 lv (11 juv); Stn KD04, 1 sh; Stn KD28, 27 lv (3 juv); Stn KD37, 4 lv (1 juv); Stn KD60, 4 lv; Stn KD67, 1 lv; Stn KD85, 1 sh; Stn KD86, 2 sh; Stn KD90, 3 lv (2 juv); Stn KL03, 41 lv (16

juv); Stn KM24, 7 lv; Stn KPS02, 1 sh; Stn KPS10, 1 sh; Stn KPS11, 3 sh; Stn KPS12, 4 lv; Stn KPS13, 1 sh; Stn KR186, 1 sh; Stn KS19, 2 lv; Stn KS21, 1 lv; Stn KS27, 1 lv + 2 sh; Stn KS31, 1 lv; Stn KS35, 2 lv; Stn KS55, 1 sh; Stn KS57, 2 lv; Stn KS59, 2 lv; Stn KZ16, 36 lv (10 juv); Stn KZ23, 15 lv (1 juv) + 1 sh; Stn KZ25, 25 lv (6 juv) + 2 sh; Stn no data, 9 lv (2 juv).

Distribution

Japan, New Caledonia, Vanuatu, Tonga, Fiji, PNG, West and East Australia, Maldives, Andaman, Thailand, Philippines.

Diagnosis

Shell of average size for the genus. Tube subcylindrical, smooth, tapering toward the apex, bent toward the aperture. Aperture simple, contracted. Septum low dome shaped, slightly protruding without mucro. The shell often shows brown and/or white bands arranged in collabral or zigzag pattern. Adult shell length about 2.5 mm.

Soft parts: head-foot colourless, semitransparent, showing a strip of crowded speckles on the neck, distantly divided into two branches touching the eyes.

Remarks

C. japonicum is a widespread and very common species, showing a variety of colour patterns that enable easy identification, although colourless specimens occur. In this species, the periostracum consists of collabral ridges, from which occasionally some hair-like projections develop (Fig. 1L, M). These hairs are normally not seen as they are adherent to the tube wall. However, in living specimens they are free and give the shell a hairy appearance (Fig. 7D).

Genus *Mauroceras* Vannozzi, 2019

(type species *Meioceras kajiymai* Habe, 1963 from Japan by original designation, Vannozzi, 2019: p. 56)

Remarks

The species from IWP hitherto classified under the genus *Meioceras* Carpenter, 1859 have been recently assigned to a separate genus due to the peculiarities of both protoconch and early teleoconch.

Mauroceras boucheti (Pizzini & Raines, 2011)

Meioceras boucheti Pizzini & Raines, 2011: pp. 42-43, fig. 6I-K.

Meioceras boucheti - Pizzini et al., fig. 40, fig. 15I, J.

Mauroceras boucheti - Vannozzi, 2019: fig. 1D-F.

Type material

Holotype MNHN-IM-2000-22069, 1 paratype MNHN and 1 paratype LACM.

Type locality

Society, Tahiti, Arue.

Material examined

The holotype and:
PNG. Stn KB28, 1 sh.

Distribution

French Polynesia, Fiji, New Caledonia and PNG.

Diagnosis

Shell small for the genus, whitish, smooth. Tube short, gibbous, very inflated with strongly convex dorsal side and convex ventral side. Septum slightly protruding with sharp dorsal mucro. Protoconch planorbic of 1.25 whorls with a deep sinusigera. Early teleoconch loosely coiled, trochospiral, deviating from the protoconch after about ½ whorl. Adult shell length about 1.6 mm.

Remarks

M. boucheti is easily recognizable due to its very inflated shell with convex ventral size.

Mauroceras amamiense (Habe, 1978)

(Fig. 5N-W)

Fartulum amamiensis Habe, 1978: pl. 1, figs 7-9.

Caecum sp. - Geiger et al., 2007: fig. 1J.

Caecum cf. *amamiense* - Vannozzi, 2017: p. 135.

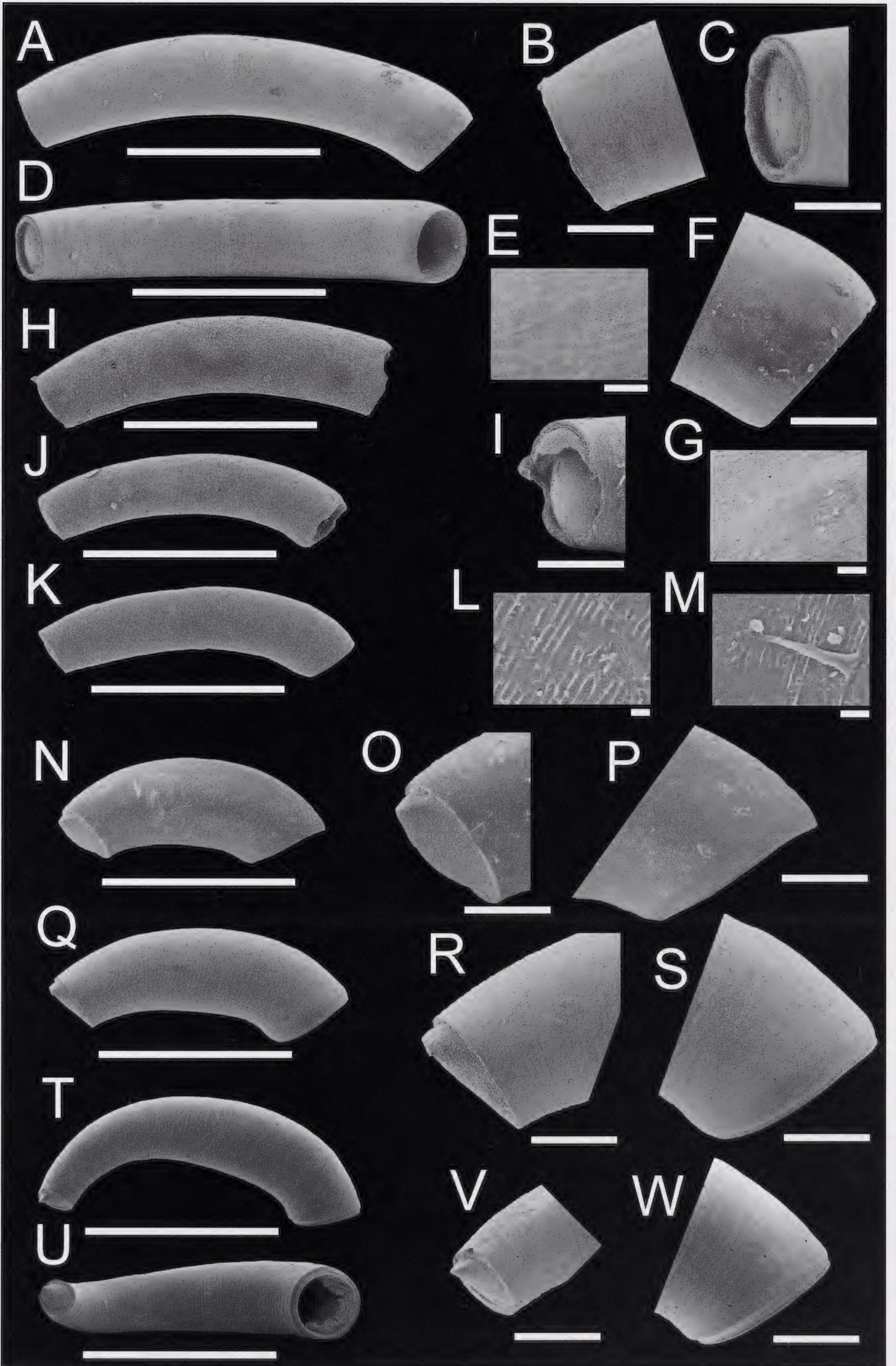
Mauroceras amamiense - Vannozzi, 2019: fig. 1G, H.

Type material

Holotype NSMT - Mo 55444 and 2 paratypes NSMT - Mo 55445 (all NMNS).

Fig. 5. A-J. *Caecum neoguineanum* n. sp.; **A-G.** holotype MNHN-IM-2000-34766, Stn PS40; **A.** side view; **B.** septum; **C.** septum in ventral view; **D.** ventral view; **E.** sculpture in the adapical part; **F.** aperture; **G.** microsculpture; **H, I.** paratype MNHN-IM-2000-34767, Stn PS40; **H.** side view; **I.** septum in ventral view; **J.** paratype MNHN-IM-2000-34768, Stn PD10. **K-M.** *Caecum japonicum*, Stn PB30; **K.** side view; **L.** microsculpture of the periostracum; **M.** periostracal hair. **N-W.** *Mauroceras amamiense*; **N-P.** Stn KB60; **N.** side view; **O.** septum; **P.** aperture; **Q-S.** Stn PB30; **Q.** side view; **R.** septum; **S.** aperture; **T-W.** growth stage, Stn PS41; **T.** side view; **U.** ventral view; **V.** septum; **W.** aperture. Scale bars: 1 mm (A, D, H, J, K, N, Q, T, U); 200 µm (B, C, F, I, O, P, R, S, V, W); 20 µm (E); 5 µm (M); 2 µm (G, L).

Fig. 5. A-J. *Caecum neoguineanum* n. sp.; **A-G.** olotipo MNHN-IM-2000-34766, Stn PS40; **A.** vista laterale; **B.** setto; **C.** setto in vista ventrale; **D.** vista ventrale; **E.** scultura nel tratto adapicale; **F.** apertura; **G.** microscultura; **H, I.** paratipo MNHN-IM-2000-34767, Stn PS40; **H.** vista laterale; **I.** setto in vista ventrale; **J.** paratipo MNHN-IM-2000-34768, Stn PD10. **K-M.** *Caecum japonicum*, Stn PB30; **K.** vista laterale; **L.** microscultura del periostraco; **M.** pelo del periostraco. **N-W.** *Mauroceras amamiense*; **N-P.** Stn KB60; **N.** vista laterale; **O.** setto; **P.** apertura; **Q-S.** Stn PB30; **Q.** vista laterale; **R.** setto; **S.** apertura; **T-W.** stadio di crescita, Stn PS41; **T.** vista laterale; **U.** vista ventrale; **V.** setto; **W.** apertura. Scala: 1 mm (A, D, H, J, K, N, Q, T, U); 200 µm (B, C, F, I, O, P, R, S, V, W); 20 µm (E); 5 µm (M); 2 µm (G, L).



Type locality

Japan, Amami I.

Material examined

The type material and:

PNG. Stn PB06, 1 sh; Stn PB10, 1 sh; Stn PB13, 4 sh (1 juv); Stn PB20, 1 sh; Stn PB29, 1 sh; Stn PB30, 4 sh; Stn PS08, 1 sh; Stn PS41, 1 sh gs; Stn KB06, 2 sh; Stn KB26, 1 sh; KB50, 5 sh; Stn KB60, 1 sh.

Distribution

Japan, Philippines, PNG, New Caledonia, Fiji, Loyalty, Vanuatu.

Diagnosis

Shell of average size for the genus. Tube subcylindrical, relatively short, smooth, bent ventrally toward the aperture. Aperture simple, strongly inclined toward the ventral side. Septum slightly protruding with a pointed, dorsal mucro. Protoconch planispiral of about 1.25 whorls. Early teleoconch loosely coiled, of about $\frac{1}{2}$ whorl. Adult shell length about 1.7 mm.

Remarks

The shape of the tube in *M. amamiense* is rather variable. In fact, the dorsal side varies from rather straight to evenly arched. The presence of a fine sculpture had never been reported in the literature (Habe, 1978; Hasegawa, 2000), but was observed in most specimens from PNG.

M. amamiense can be compared with *M. sandwichense* (de Folin, 1881) and *M. maestratii*. However, *M. sandwichense* is always smooth and shows an evenly convex dorsal side and a more tapering tube, while *M. maestratii* is larger, straight adapically and shows a clear sculpture of fine rings.

Mauroceras maestratii
(Pizzini, Raines & Vannozzi, 2013)

Caecum maestratii Pizzini, Raines & Vannozzi, 2013: p. 17, fig. 10G-J.

Type material

Holotype MNHN-IM-2000-24837 and several paratypes (all MNHN).

Type locality

Loyalty, between Cape Wekutr and Cape Wajej.

Material examined

The type material (ph) and:

PNG. Stn PB30, 2 sh; Stn PB31, 1 sh; Stn PB36, 1 sh; Stn

PS40, 1 sh; Stn KB26, 2 sh; Stn KB38, 1 sh; Stn KPS02, 1 sh.

Distribution

Loyalty, Philippines, PNG, Fiji, Vanuatu and New Caledonia.

Diagnosis

Shell of average size for the genus. Tube subcylindrical, weakly curved, slightly twisted, with a strong bending before the aperture, which is slightly flaring. Sculpture of very fine and regular small rings. Septum slightly protruding with a sharp, pointed dorsal mucro. Adult shell length about 2.5 mm.

Remarks

This species is rather distinctive and can be compared only with *M. amamiense*. See remarks under this species for comparison. The inclusion of this species into the genus *Mauroceras* is tentative and needs confirmation.

Mauroceras serratum (Vannozzi, 2017)

Meioceras serratum Vannozzi, 2017: p. 136, fig. 3F-N.

Type material

Holotype MNHN-IM-2000-33080 and 2 paratypes (all MNHN).

Type locality

Philippines, Bohol I.

Material examined

The type material and:
PNG. Stn PS40, 1 sh.

Distribution

Philippines, PNG, Celebes Is., Society Is., Marshall Is.

Diagnosis

Shell of average size for the genus. Tube subcylindrical, slightly arched, colourless, glossy. Sculpture of strong, flat rings dilated abapically, appearing as imbricated one another, on the whole giving a saw-tooth profile to the shell. Aperture simple, inclined, cutting the last two rings. Surface smooth with growth lines only. Septum on the cutting plane with a strong pointed mucro, rounded in ventral view. Adult shell length about 2.5 mm.

Remarks

M. serratum is a distinctive species due to the strong

sculpture of large, flat rings and can only be compared with *C. rostratum* de Folin, 1881. However, the latter shows a clear longitudinal microsculpture, whereas in *M. serratum* only growth lines are visible at strong magnification. Moreover, the aperture is not inclined but is parallel to the rings in *C. rostratum*, whereas in *M. serratum* the aperture is inclined and slantwise cuts the last two rings. The inclusion of this species into the genus *Mauroceras* is tentative and needs confirmation.

Mauroceras kajiyamai (Habe, 1963)

Meioceras kajiyamai Habe, 1963: p. 235, fig. 5.

†*Caecum parryensis* Ladd, 1972: p. 23, pl. 5, figs 1-7.

†*Micranellum schlangeri* Ladd, 1972: p. 23, pl. 5, figs 13, 14.

†*Fartulum* sp. A Ladd, 1972: p. 23, pl. 5, fig. 18.

Fartulum kajiyamai - Habe, 1978: p. 4.

Fartulum kajiyamai - Hasegawa, 2000: p. 173, pl. 86, fig. 8.

Meioceras kajiyamai - Pizzini & Raines, 2011: fig. 5I.

Meioceras kajiyamai - Pizzini et al., 2013: p. 41, fig. 15L, M.

Meioceras kajiyamai - Vannozzi, 2017: p. 136, 137, fig. 3A-E.

Mauroceras kajiyamai - Vannozzi, 2019: fig. 1I-L.

Type material

Holotype NMNS.

Type locality

Japan, Amami-Oshima, Ankyaba, Kakeroma Jima.

Material examined

The holotype (ph) and:

PNG. Stn PB01, 4 sh; Stn PB10, 5 sh; Stn PB13, 8 lv (4 juv) + 10 sh (1 juv); Stn PB14, 1 sh; Stn PB16, 1 sh; Stn PB20, 4 sh (3 juv); Stn PB22, 2 lv (1 juv) + 7 sh (2 juv); Stn PB29, 5 lv (1 juv) + 12 sh (2 juv); Stn PB30, 26 sh (4 juv); Stn PB31, 1 sh; Stn PB32, 7 sh; Stn PB35, 1 sh; Stn PB36, 1 sh; Stn PB38, 1 sh; Stn PB40, 3 lv + 22 sh (8 juv); Stn PB41, 1 sh; Stn PB51, 2 sh; Stn PD48, 1 sh juv; Stn PD63, 1 sh juv; Stn PS03, 6 sh (1 juv); Stn PS12, 1 sh; Stn PS17, 2 sh; Stn PS22, 1 sh; Stn PS30, 1 sh; Stn PS31, 8 lv + 16 sh; Stn PS36, 2 sh; Stn PS38, 5 sh; Stn PS40, 16 sh (1 juv); Stn PS41, 92 sh (4 juv, 3 gs); Stn PS42, 1 sh; Stn PS43, 1 lv + 1 sh juv; Stn PS44, 1 lv + 1 sh; Stn KB02, 1 sh; Stn KB06, 1 sh; Stn KB14, 1 sh; Stn KB18, 8 sh (3 juv); Stn KB20, 1 sh; Stn KB22, 1 sh; Stn KB26, 3 sh (1 juv); Stn KB28, 6 sh (3 juv); Stn KB38, 1 sh; Stn KB50, 7 sh (4 juv); Stn KB70, 5 sh (2 juv); Stn KB72, 2 sh; Stn KPR06, 2 sh; Stn KPS02, 18 sh (4 juv); Stn KPS09, 1 sh; Stn KPS10, 2 sh; Stn KPS11, 1 sh; Stn KPS17, 20 sh (8 juv); Stn KR186, 3 sh (2 juv); Stn KS09, 1 sh; Stn KS19, 5 sh; Stn KS25, 4 sh; Stn KS39, 1 sh; Stn KS61, 1 sh; Stn KZ16, 1 sh juv.

Distribution

IWP from tropical eastern Africa to Maldives, Philippines, PNG, Japan, New Caledonia, Vanuatu and Fiji.

Diagnosis

Shell of average size for the genus, semitransparent whitish, glossy. Tube subcylindrical, tapering toward both the apex and the aperture. Maximum width located at about $\frac{1}{4}$ of the length close to the aperture. Sculpture of fine, regular rings. Septum on the cutting plane, with a strong mucro, showing a straight dorsal side and a sloping, slightly convex ventral side. Contrary to the adult stage, the young stage shows a rapid growth and a cow-horn shape. Protoconch planispiral of 1.25 whorls with a shallow sinusigera. Adult shell length about 2.7 mm.

Remarks

M. kajiyamai is a common and widespread species and shows no difficulty for identification due to its peculiar shape. Juveniles are rather different from adults, showing a narrow, openly coiled and rapidly expanding tube with clear annular sculpture.

Mauroceras rhinoceros (Pizzini, Raines & Vannozzi, 2013)

Meioceras rhinoceros Pizzini, Raines & Vannozzi, 2013: p. 41, fig. 16A-C.

Strebloceras kilburni Pizzini, Raines & Vannozzi, 2013: p. 51, 53, fig. 18H-K.

Mauroceras rhinoceros - Vannozzi, 2019: fig. 1M-P.

Type material

Holotype MNHN 24880 and 1 paratype MNHN 24881; 2 paratypes AMS C044117 - n. 003958B; 1 paratype LACM 88-55; 1 paratype (IK).

Type locality

Loyalty I., Lifou.

Material examined

The type material (ph) and:

PNG. Stn KPS02, 2 sh (1 larval).

Distribution

PNG, North Sulawesi, Indonesia, Philippines.

Diagnosis

Shell very large for the genus. Tube smooth, subcylindrical up to about $\frac{2}{3}$ the entire length and contracting toward the aperture, which is very oblique and rimmed by the reflected lip. Sculpture of faint annulation, more defined close to the aperture. Septum below the cutting plane, with a hook-like mucro projecting well beyond the cutting plane. Protoconch planispiral of $1\frac{1}{4}$ whorls with a shallow sinusigera. Early teleoconch conical, rather straight. Adult shell length about 6 mm.

Remarks

M. rhinoceros is a very distinctive species due to its very large size, the smooth, almost straight tube and the hook-like mucro. *Strebloceras kilburni* is recognized as the young stage of this species.

Subfamily Ctiloceratinae Iredale & Laseron, 1957

This subfamily includes species with protoconch consisting of an early coiled portion and a late uncoiled portion, usually ending with a varix. The teleoconch is tubular (genus *Parastrophia*) or trochospiral (genera *Ctiloceras* and *Ponderoceras*).

Genus *Parastrophia* de Folin, 1869

(Type species *Moreletia cornucopiae* de Folin, 1869 from Hong-Kong by original designation, de Folin, 1869b: p. 174).

Parastrophia de Folin, 1869b: p. 174 (non Hall & Clarke 1895 (Brachiopoda)).

? *Spirolidium* O.G. Costa, 1861: p. 64.

Moreletia de Folin, 1869a: p. 120 (non Gray, 1855: 148 (Pulmonata: Zonitidae)).

Watsonia de Folin, 1880: p. 807.

Pseudoparastrophia Distaso, 1905: p. 436.

Pedumicra Iredale & Laseron, 1957: p. 104.

Gladioceras Iredale & Laseron, 1957: p. 105.

Parastrophia cornucopiae (de Folin, 1869) (Fig. 6A-H)

Moreletia cornucopiae de Folin, 1869a: p. 122, pl. 15, figs 7-9.

Type material

Lectotype MNHN-IM-2000-24917 selected by Pizzini et al. (2013) and 2 paralectotypes (all MNHN).

Type locality

Hong-Kong.

Material examined

The type material (ph) and:

PNG. Stn PB14, 1 sh juv; Stn PB14, 1 sh; Stn PD02, 2 sh; Stn PD03, 1 sh; Stn PD04, 3 sh; Stn PD06, 1 sh; Stn PD07, 3 sh; Stn PD14, 1 lv + 19 sh; Stn PD17, 1 sh; Stn PD18, 1 sh; Stn PD20, 1 lv + 3 sh (2 juv); Stn PD27, 1 sh juv; Stn PD43, 2 sh (worn); Stn PD63, 9 sh (2 juv); Stn PD66, 5 sh; Stn PD69, 1 sh; Stn PD86, 11 sh (2 juv); Stn PS14, 1 lv + 9 sh; Stn PS39, 2 sh; Stn KD06, 1 sh worn; Stn KD07, 1 sh worn; Stn KD85, 3 sh.

Distribution

Hong-Kong, PNG.

Diagnosis

Shell of average size for the genus, smooth, colourless,

rather glossy, semitransparent. Coiled protoconch small of $\frac{1}{2}$ whorl. Uncoiled protoconch slender, rather straight, ending with a clear varix showing a crown of small tubercles. Late protoconch showing some very fine, widely spaced longitudinal threads. Early teleoconch rapidly expanding, funnel-like. Late teleoconch inflated, contracted toward the aperture, which is inclined. There is a slight swelling before the aperture in the ventral side. Surface smooth, apart from obsolete longitudinal cordlets, slightly dextrally wound, only visible on the early teleoconch. Adult shell length about 4 mm.

Remarks

This is the type species of the genus *Parastrophia* de Folin, 1869. However, the identity of *Moreletia cornucopiae* remained so far unclear due to the puzzling original drawing and poor condition of the type material. Moore (1976) defined the original drawing as "extremely fanciful". In fact, it shows an unusual shape and it is impossible to say whether de Folin described an anomalous specimen or rather exaggerated some characters to highlight details he considered important for identification. Moreover, de Folin described the apex of the shell as showing a peripheral crest which has been never observed in any *Parastrophia* so far examined. However, the species from PNG agrees rather well with the original description of *P. cornucopiae*, including the large size, the funnel-shaped early teleoconch showing longitudinal striation, the inflated teleoconch and the contracted aperture. Apart from a single specimen, all material from PNG consists of adult shells with broken protoconch and juveniles showing the characteristic funnel shape (Fig. 6A-H). Although the type material of *Parastrophia cornucopiae* consists only of juveniles without coiled protoconch, the shape of the juveniles from PNG agrees with the type material due to the shape of the early teleoconch and the presence of faint longitudinal cords. Therefore, I identified the species from PNG as *P. cornucopiae*. *P. sumatrana* (Thiele, 1925) from Indonesia may be this species.

P. cf. cornucopiae reported from the Central Philippines (Vannozi, 2017) differs from the species from PNG. In fact, the former is smaller, the early teleoconch develops less rapidly and the aperture is not clearly contracted. These characters are shown also by *Parastrophia filum* Melvill, 1906 from Oman, initially synonymized with *P. cornucopiae* but which I prefer to keep separated until more is known about the smooth *Parastrophia* from the IWP.

Parastrophia ivani Vannozi, 2017 ex Pizzini MS (Fig. 7J)

Parastrophia ivani Vannozi, 2017 ex Pizzini MS: p. 141, fig. 5A-H.

Type material

Holotype MNHN-IM-2000-33125 and 4 paratypes (all MNHN).

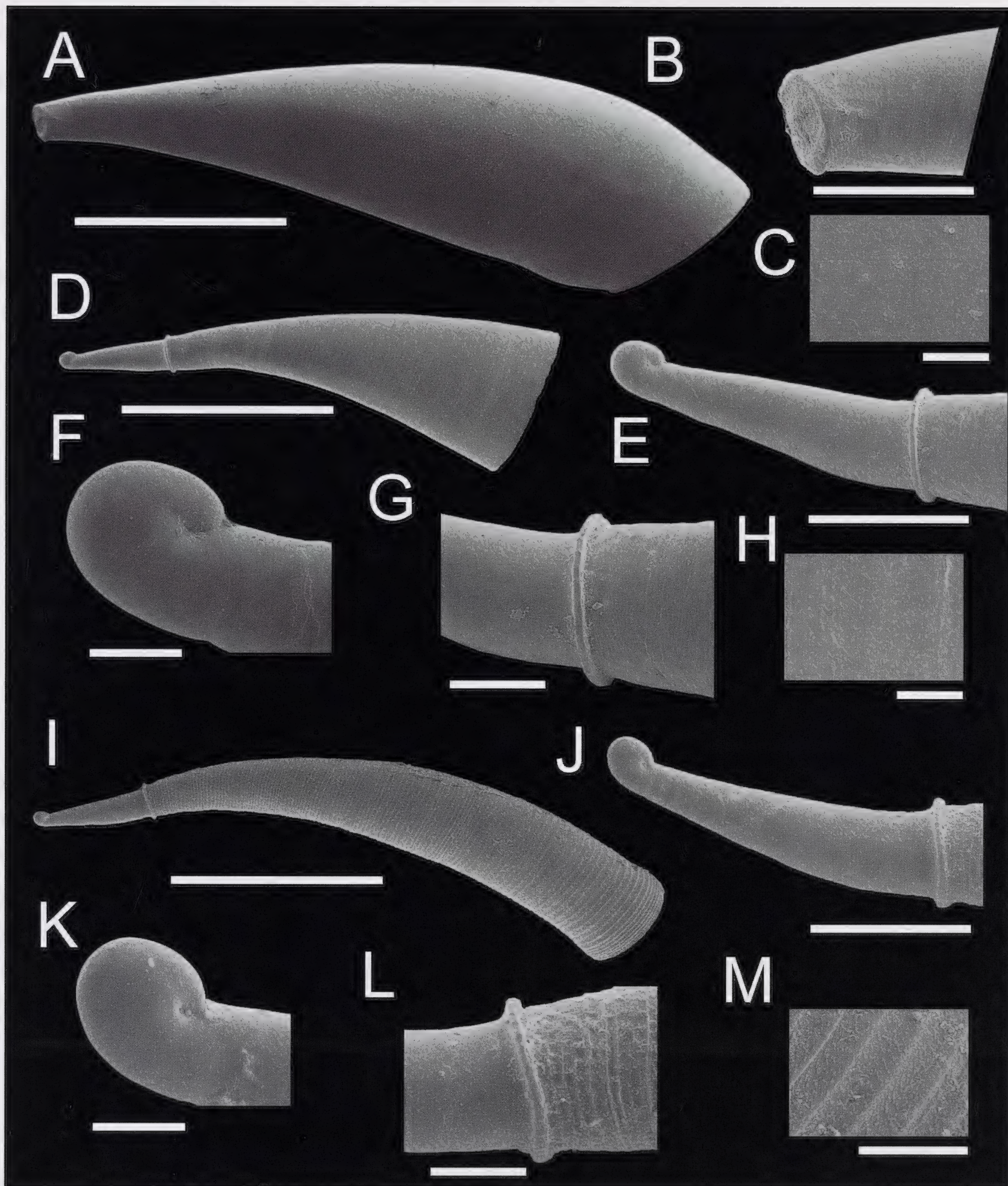


Fig. 6 A-H. *Parastrophia cornucopiae*; **A-C.** adult, Stn PD02; **A.** side view; **B.** truncated apex; **C.** detail of the surface; **D-H.** juv, Stn PD66; **D.** side view; **E.** protoconch; **F.** coiled protoconch; **G.** varix; **H.** detail of the surface. **I-M.** *Parastrophia japonica*, Stn KB40; **I.** side view; **J.** protoconch; **K.** coiled protoconch; **L.** varix; **M.** microsculpture. Scale bars: 1 mm (A, D, I); 250 μ m (B, E, J); 100 μ m (G, L, M); 50 μ m (F, K); 20 μ m (C, H).

Fig. 6 A-H. *Parastrophia cornucopiae*; **A-C.** adulto, Stn PD02; **A.** vista laterale; **B.** apice troncato; **C.** dettaglio della superficie; **D-H.** juv, Stn PD66; **D.** vista laterale; **E.** protoconca; **F.** protoconca iniziale; **G.** varice; **H.** dettaglio della superficie. **I-M.** *Parastrophia japonica*, Stn KB40; **I.** vista laterale; **J.** protoconca; **K.** protoconca iniziale; **L.** varice; **M.** microscultura. Scala: 1 mm (A, D, I); 250 μ m (B, E, J); 100 μ m (G, L, M); 50 μ m (F, K); 20 μ m (C, H).

Type locality

Philippines, Panglao Islands.

PNG. Stn PB30, 1 sh cf; Stn PD66, 2 sh (1 broken); Stn KB40, 1 lv; Stn KB46, 1 sh; Stn KB70, 1 lv juv; Stn KPS02, 1 sh broken.

Material examined

The type material and:

Distribution

Philippines, PNG.

Diagnosis

Shell small for the genus, colourless, semitransparent. Small coiled protoconch of $\frac{1}{2}$ whorl. Uncoiled protoconch conical, somewhat inflated, ending with a clear varix showing longitudinal microsculpture. Late protoconch showing some very fine, closely spaced longitudinal threads. Teleoconch conical, narrow, arched, sculptured by fine, irregular rings, sometimes vanishing in the late teleoconch. Surface showing a strong longitudinal microsculpture. Aperture simple, slightly expanded in mature specimens. Adult shell length about 2.5 mm. Soft parts: head-foot colourless, semitransparent, showing thick semicircular spots of speckles above the eyes and some isolated speckles below.

Remarks

For comparison with similar species see remarks under *P. japonica*.

Parastrophia ingens Vannozzi, 2017, ex Pizzini MS

Parastrophia ingens Vannozzi, 2017, ex Pizzini MS: p. 143, fig. 5I-L.

Type material

Holotype MNHN-IM-2000-33089 and 2 paratypes (all MNHN).

Type locality

Philippines, Panglao I.

Material examined

The type material and:
PNG. Stn KB28, 1 sh juv.

Distribution

Philippines, PNG.

Diagnosis

Shell of average size for the genus, colourless, semitransparent. Coiled protoconch small of $\frac{1}{2}$ whorl. Uncoiled protoconch slender, ending with a clear varix showing longitudinal microsculpture. Late protoconch showing some very fine, closely spaced longitudinal threads. Teleoconch conical, rather straight, sculptured by fine, regular rings. Surface showing a longitudinal

microsculpture stronger in the early teleoconch. Aperture simple, oblique. Adult shell length about 4 mm.

Remarks

Only a juvenile specimens occurred in the examined material. For comparison with similar species see remarks under *P. japonica*.

Parastrophia cecalupoi Vannozzi, 2017

Parastrophia cecalupoi Vannozzi, 2017: p. 143, 144, fig. 5M-O.

Type material

Holotype MNHN-IM-2000-33091 and 4 paratypes (all MNHN).

Type locality

Philippines, Bohol I.

Material examined

The type material and:
PNG. Stn PB14, 1 sh; Stn PD23, 1 sh; Stn PD30, 1 sh; Stn PD63, 1sh; Stn PD66, 5 sh (1 cf); Stn PS05, 2 sh cf; Stn PS06, 1 sh; Stn PS22, 1 sh cf; Stn KB06, 1 sh; Stn KB18, 1 lv; Stn KD86, 2 sh.

Distribution

Philippines, PNG.

Diagnosis

Shell of average size for the genus, colourless, semitransparent. Coiled protoconch small of $\frac{1}{2}$ whorl. Uncoiled protoconch slender, short, ending with a clear varix showing longitudinal microsculpture. Late protoconch showing some very fine, closely spaced longitudinal threads. Teleoconch conical, arched, sculptured by fine, regular rings, obsolete in the early teleoconch. Surface showing a longitudinal microsculpture stronger in the early teleoconch. Aperture simple, slightly expanded in mature specimens. Adult shell length about 3.5 mm.

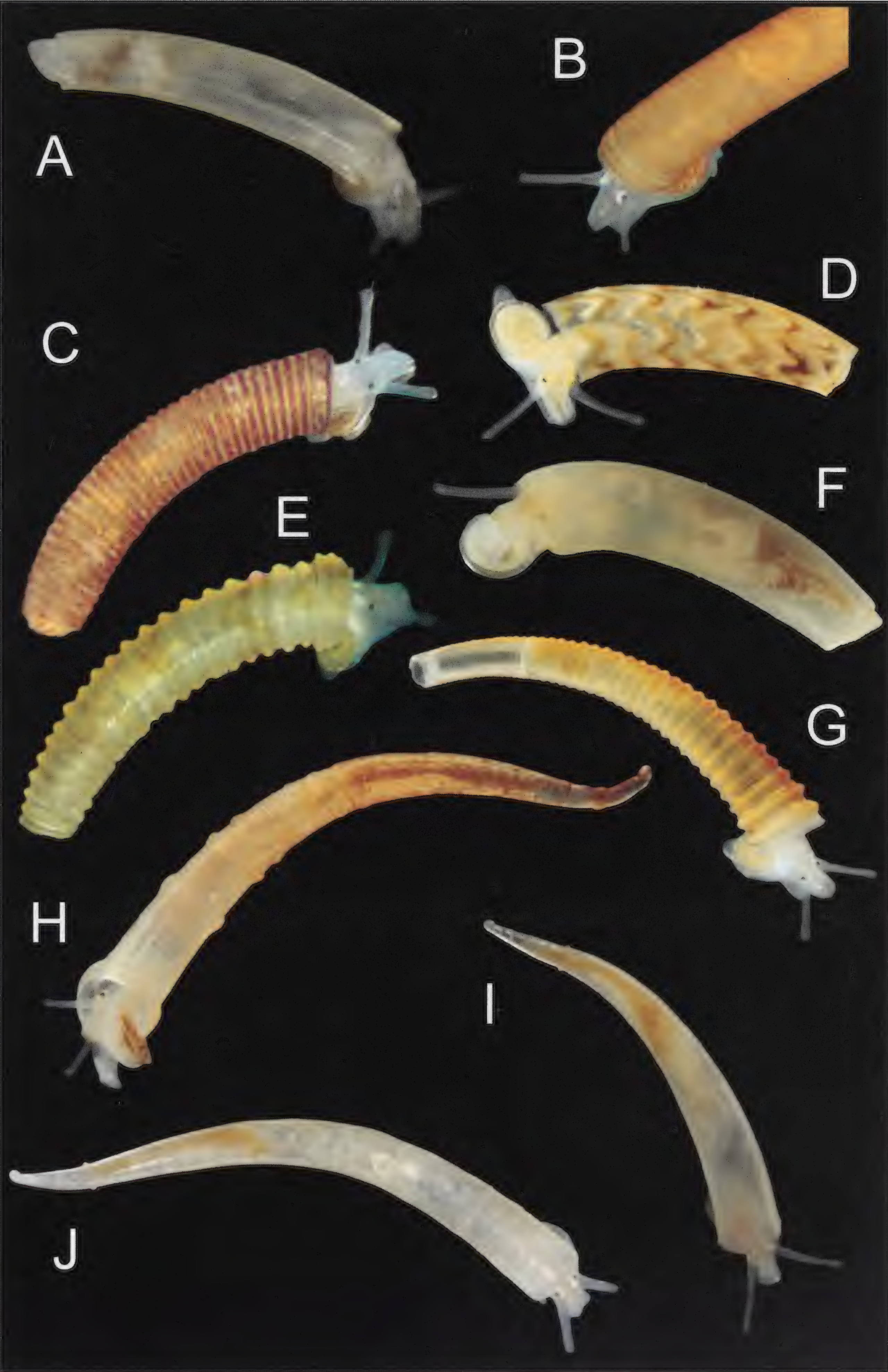
Remarks

For comparison with similar species see remarks under *P. japonica*.

Parastrophia japonica Hinoide & Habe, 1978 (Fig. 7I)

Fig. 7. A-J. Pictures of living Caecidae specimens from PNG. **A.** *Caecum inflatum*, Stn KD28; **B.** *Caecum neocaledonicum*, Stn PM27; **C.** *Caecum oahuense*, Stn PM27; **D.** *Caecum japonicum*, Stn PD07; **E.** *Caecum sepimentum*, Stn PB31; **F.** *Caecum modestum*, Stn PD07; **G.** *Caecum cf. vertebrale* juv, Stn PD18; **H.** *Parastrophia vanuatuensis*, Stn PS43; **I.** *Parastrophia japonica*, Stn PR22; **J.** *Parastrophia ivani*, Stn KB40. Specimens not to scale.

Fig. 7. A-J. Foto di esemplari viventi di Caecidae da PNG. **A.** *Caecum inflatum*, Stn KD28; **B.** *Caecum neocaledonicum*, Stn PM27; **C.** *Caecum oahuense*, Stn PM27; **D.** *Caecum japonicum*, Stn PD07; **E.** *Caecum sepimentum*, Stn PB31; **F.** *Caecum modestum*, Stn PD07; **G.** *Caecum cf. vertebrale* juv, Stn PD18; **H.** *Parastrophia vanuatuensis*, Stn PS43; **I.** *Parastrophia japonica*, Stn PR22; **J.** *Parastrophia ivani*, Stn KB40. Esemplari non in scala.



Parastrophia japonica Hinoide & Habe, 1978: p. 56, figs 1-3.
Parastrophia cf. *japonica* - Pizzini et al., 2013: p. 45, fig. 16P-R.
Parastrophia cf. *japonica* - Vannozzi, 2017: p. 144, fig. 5P.

Type material

Holotype NSMT-Mo 55474 and 2 paratypes NSMT-Mo 55475 and 55476 (all NMNS).

Type locality

Japan, Amami I.

Material examined

The type material and:
PNG. Stn KB06, 2 sh; Stn KB38, 1 lv + 1 sh; Stn KB40, 1 sh; Stn KB54, 1 sh; Stn KZ16, 1 lv + 1 sh.

Distribution

Japan, Philippines, PNG.

Diagnosis

Shell small for the genus, colourless, semitransparent. Coiled protoconch small of $\frac{1}{2}$ whorl. Uncoiled protoconch slender, ending with a clear varix showing longitudinal microsculpture. Late protoconch showing some very fine, closely spaced longitudinal threads. Teleoconch conical, arched, sculptured by fine, somewhat irregular rings, denser in the early teleoconch. Surface showing a longitudinal, somewhat zigzagging microsculpture stronger in the early teleoconch. Aperture simple, slightly expanded in mature specimens. Adult shell length about 3 mm.

Soft parts: head-foot colourless, semitransparent, showing semicircular spots of speckles above the eyes.

Remarks

Specimens from PNG show no differences with respect to the type material of *P. japonica* and have been identified accordingly. The presence of both sculpture and microsculpture were not mentioned in the original description. However, optical photographs of the type material shows that at least the annular sculpture occurs (Vannozzi, 2017). *P. japonica* occurred only in the material from the KAVIENG Expedition.

P. cecalupoi, *P. ivani*, *P. ingens* and *P. japonica* form a complex of species sharing a number of characters such as the paucispiral coiled protoconch, the sculptured varix, the reticulated microsculpture in the early teleoconch, the presence of a fine annular sculpture, the longitudinal microsculpture and the absence of a strong apertural varix. The main differences among these species consist in size, shape and inclination of the protoconch and size and shape of the teleoconch. *P. ingens* is characterized by a large, conical and little curved teleoconch and by the protoconch inclined laterally. On the other

hand, *P. ivani* is characterized by a small and slender teleoconch with variable sculpture and a proportionally large protoconch inclined both ventrally and laterally. *P. cecalupoi* and *P. japonica* are very similar one to each other, sharing similar size and general appearance. However direct comparison allows unequivocal identification. In fact, *P. cecalupoi* shows a very short protoconch and a proportionally wider teleoconch.

Parastrophia megadattilida Pizzini, Raines & Vannozzi, 2013

Parastrophia megadattilida Pizzini, Raines & Vannozzi, 2013: p. 47, figs. 17F-I.

Parastrophia elegans - Bandel, 1996: pl. 9, figs 3, 4 (non de Folin, 1880).

Type material

Holotype MNHN-IM-2000-24894 and 9 paratypes (all MNHN).

Type locality

Vanuatu I., W Tutuba I., 15°34.1'S, 167°16.0'E, 70-80 m.

Material examined

The type material (ph) and:
PNG. Stn PB30, 1 sh; Stn PB51, 1 sh fragm; Stn PD04, 1 sh; Stn PD66, 1 sh cf (fragm); Stn PS40, 1 sh; Stn PS41, 3 sh; Stn KB70, 12 sh.

Distribution

Vanuatu, Fiji, Philippines, PNG.

Diagnosis

Shell of average size for the genus, slender, slowly growing. Coiled protoconch of $\frac{1}{2}$ whorl, uncoiled protoconch slender, straight, ending with a strong varix. Varix showing a squarish profile and longitudinal ridges. Teleoconch with a sculpture of regular strong rings. Aperture surrounded by a strong varix. Multiple varices often occur. Microsculpture of fine longitudinal cordlets surmounting the rings. Adult shell length about 4 mm. Soft parts: head-foot colourless, semitransparent, showing rings of crowded speckles surrounding the eyes, thicker above; proximal part of the tentacles tinged with pink.

Remarks

P. megadattilida is easily identified due to the very slender teleoconch, the strong annulation and the presence of very strong, rounded varices placed at irregular intervals along the tube. See also remarks under *P. vanuatuensis*.

Parastrophia vanuatuensis
Pizzini, Raines & Vannozzi, 2013
(Fig. 7H)

Parastrophia vanuatuensis Pizzini, Raines & Vannozzi, 2013: p. 49, figs. 18E-G.

Type material

Holotype MNHN-IM-2000-24901 and 2 paratypes (all MNHN).

Type locality

Vanuatu I., Strait N Tangoa I., 15°35.7'S, 166°59.3'E, 12 m.

Material examined

The holotype (ph) and:
PNG. Stn PD66, 1 sh cf; Stn PS09, 1 sh; Stn PS31, 2 sh;
Stn PS41, 1 sh; Stn PS43, 1 lv.

Distribution

Vanuatu, New Caledonia, PNG.

Diagnosis

Shell of average size for the genus. Coiled protoconch of 1 whorl, uncoiled protoconch showing a gibbosity in the dorsal side, ending with a clear varix. Teleoconch slender, rather arched with respect to the congeners, showing a sculpture of clear regular rings. Aperture varicose. Multiple varices occur in mature specimens. Microsculpture of irregular, longitudinal grooves. Adult shell length about 4 mm.

Soft parts: head-foot colourless, semitransparent, showing semicircular spots of speckles above the eyes and some isolated speckles along the proximal part of the tentacles.

Remarks

P. vanuatuensis is similar to *P. megadattilida* due to the presence of a strong annulation and the occurrence of isolated, strong rounded varices. However, in *P. vanuatuensis* both sculpture and varices are finer and the teleoconch is less slender. Moreover, the coiled protoconch is multispiral whereas in *P. megadattilida* it is paucispiral (Pizzini et al., 2013).

Parastrophia pulcherrima
Pizzini, Raines & Vannozzi, 2013

Parastrophia pulcherrima Pizzini, Raines & Vannozzi, 2013: p. 46, fig. 17A-E.

Fartulum sp. Hughes, 1985: pp. 158-160, pl. 1B, figs 1j, 2.

Type material

Holotype MNHN-IM-2000-24891 and 2 paratypes (all MNHN).

Type locality

New Caledonia, Touho Sector.

Material examined

The type material and:
PNG. Stn KD36, 1 sh.

Distribution

New Caledonia, Hong Kong (Hughes, 1985), Philippines (MP), North Sulawesi (IP), PNG.

Diagnosis

Shell of average size for the genus, colourless, openly coiled. Coiled protoconch of $\frac{3}{4}$ whorl, uncoiled protoconch rather short with a clear varix showing a microsculpture of longitudinal ridges. Early teleoconch openly coiled, rapidly growing, of about 1 whorl. Late teleoconch uncoiled, subcylindrical, slightly arched, showing a sculpture of irregular rings. Aperture simple. Surface showing a longitudinal microsculpture stronger in the early teleoconch. Adult shell length about 3.5 mm.

Remarks

This species is unique due to the combination of an openly coiled early teleoconch and a simple, curved late teleoconch.

Discussion

The present work is based on 2600 specimens coming from 167 stations, covering a depth range between 0 and 60 m. The family Caecidae in North Papua-New Guinea is represented by 37 species, very close to the number (36) recently reported from the Central Philippines, 24 of which occurring in both regions. Only the genera *Caecum*, *Mauroceras* and *Parastrophia* are represented, with 23, 6 and 8 species, respectively. As observed in other regions, the subfamily Caecinae is by far the most represented both in terms of species recorded (about 78%) and number of specimens collected (95%). The 4 most abundant species (*C. japonicum*, *M. kajiya-mai*, *C. modestum* and *C. sepimentum*) account for 86% of all specimens. In particular, the most abundant species is by far *C. japonicum*, with over 45% of all specimens. Within the genus *Parastrophia*, *P. cornucopiae* is the most common species with 57% of all specimens of this genus. On the other hand, eight species of Caecidae are represented by a single specimen. This suggests that the number of species reported in the present work from northern PNG may be underestimated. The station showing the highest number of species is Stn KB26 with 11 species, whereas the one with the highest number of specimens is KB06 with 220 specimens, of which 87% are *C. japonicum*.

Six species have been described as new, all belonging to the genus *Caecum*. A single worn specimen not identifiable with any known species has been also reported. Although well characterized, its description as a new species is postponed until more material is available.

Little is known about the soft parts of the Caecidae. In fact, they have been described in a few cases only (Clark, 1849; Distaso, 1905; Götze, 1938; Moore, 1962; Morton, 1975; Panetta, 1980; Bandel, 1996). As a consequence, the taxonomy of this family is currently almost entirely based on shell morphology.

However, thanks to the pictures taken from living specimens soon after sampling, more and more images of IWP Caecidae are known and some general features can be recognized (see also Pizzini et al., 2013: figs 20 and 21). In Fig. 7, pictures of living specimens collected during both PAPUA-NIUGINI and KAVIENG Expeditions are shown. The external morphology is rather constant among different species, consisting of an almost colourless and transparent head-foot, a long extensible snout and black eyes at the base of each cephalic tentacle. The end of tentacles often appears club-shaped and show stiff cilia, whereas motile cilia can be observed along the tentacles, as described by Moore (1962). Small whitish speckles can be seen above the eyes or on the neck. Speckles appear less clear in juvenile specimens. These speckles are arranged in patterns that appear to be species specific and may be used as an additional character for species determination. These observations suggest that also in the case of the Caecidae, as in other gastropod families such as Cerithiopsidae, Rissoidae, Cystiscidae, Columbellidae and Pyramidellidae (Modica et al., 2013; Villari & Scuderi, 2017; Villari, 2017; Gofas, 1990; Chiarelli et al., 2003; Høisæter, 2014), the morphology of the living animal may be useful for species identification.

Conclusion

The Caecidae collected during PAPUA-NIUGINI (2012) and KAVIENG (2014) Expeditions conducted by the MNHN (Paris) in the North Papua-New Guinea are reported. Thirty-seven species are recognized, six of which described as new and one left undetermined, waiting for additional material that may help to clarify its status. Furthermore, *Parastrophia cornucopiae* is reported for the first time after its description.

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Appendix 1

Species list

Caecum clarum Lamy (de Folin MS), 1909 - p. 75

Caecum cooki Pizzini & Raines, 2011 - p. 77

Caecum directum n. sp. - p. 82, Fig. 4A-F

Caecum egenum Vannozzi, 2017 - p. 78

Caecum frugi n. sp. - p. 80, Fig. 2V-Y

Caecum granulatum n. sp. - p. 79, Fig. 2O-U

Caecum inflatulum Vannozzi, 2017 - p. 84, Fig. 7A

Caecum japonicum (Habe, 1978) - p. 87, Figs 5K-M, 7D

Caecum kontiki Pizzini & Raines, 2011 - p. 82, Fig. 3A-E

Caecum modestum de Folin, 1868 - p. 78, Fig. 7F

Caecum musorstomi Pizzini, Raines & Vannozzi, 2013 - p. 86, Fig. 4J-N

Caecum nasutum n. sp. - p. 76, Fig. 1A-N

Caecum neocaledonicum de Folin, 1868 - p. 76, Fig. 7B

Caecum neoguineanum n. sp. - p. 87, Fig. 5A-J

Caecum nofronii n. sp. - p. 79, Fig. 2A-N

Caecum oahuense Pilsbry, 1921 - p. 74, Fig. 7C

Caecum prae grande Vannozzi, 2017 - p. 82, Fig. 3F-J

Caecum sepimentum de Folin, 1868 - p. 73, Fig. 7E

Caecum smriglioi Pizzini, Nofroni & Bonfitto, 2008 - p. 75

Caecum succineum de Folin, 1880 - p. 86

Caecum vertebrale Hedley, 1899 - p. 74, Fig. 7G

Caecum virginiae Pizzini, Raines & Vannozzi, 2013 - p. 84

Caecum sp. 2 - p. 86, Fig. 4Q-S

Mauroceras amamiense (Habe, 1978) - p. 88, Fig. 5N-W

Mauroceras boucheti (Pizzini & Raines, 2011) - p. 88

Mauroceras kaji yamai (Habe, 1963) - p. 91

Mauroceras maestratii (Pizzini, Raines & Vannozzi, 2013) - p. 90

Mauroceras rhinoceros (Pizzini, Raines & Vannozzi, 2013) - p. 91

Mauroceras serratum (Vannozzi, 2017) - p. 90

Parastrophia cecalupoi Vannozzi, 2017 - p. 94

Parastrophia cornucopiae (de Folin, 1869) - p. 92, Fig. 6A-H

Parastrophia ingens Vannozzi (Pizzini MS), 2017 - p. 94

Parastrophia ivani Vannozzi (Pizzini MS), 2017 - p. 92, Fig. 7J

Parastrophia japonica Hinoide & Habe, 1978 - p. 94, Fig. 7I

Parastrophia megadattilida Pizzini, Raines & Vannozzi, 2013 - p. 96

Parastrophia pulcherrima Pizzini, Raines & Vannozzi, 2013 - p. 97

Parastrophia vanuatuensis Pizzini, Raines & Vannozzi, 2013 - p. 97, Fig. 7H

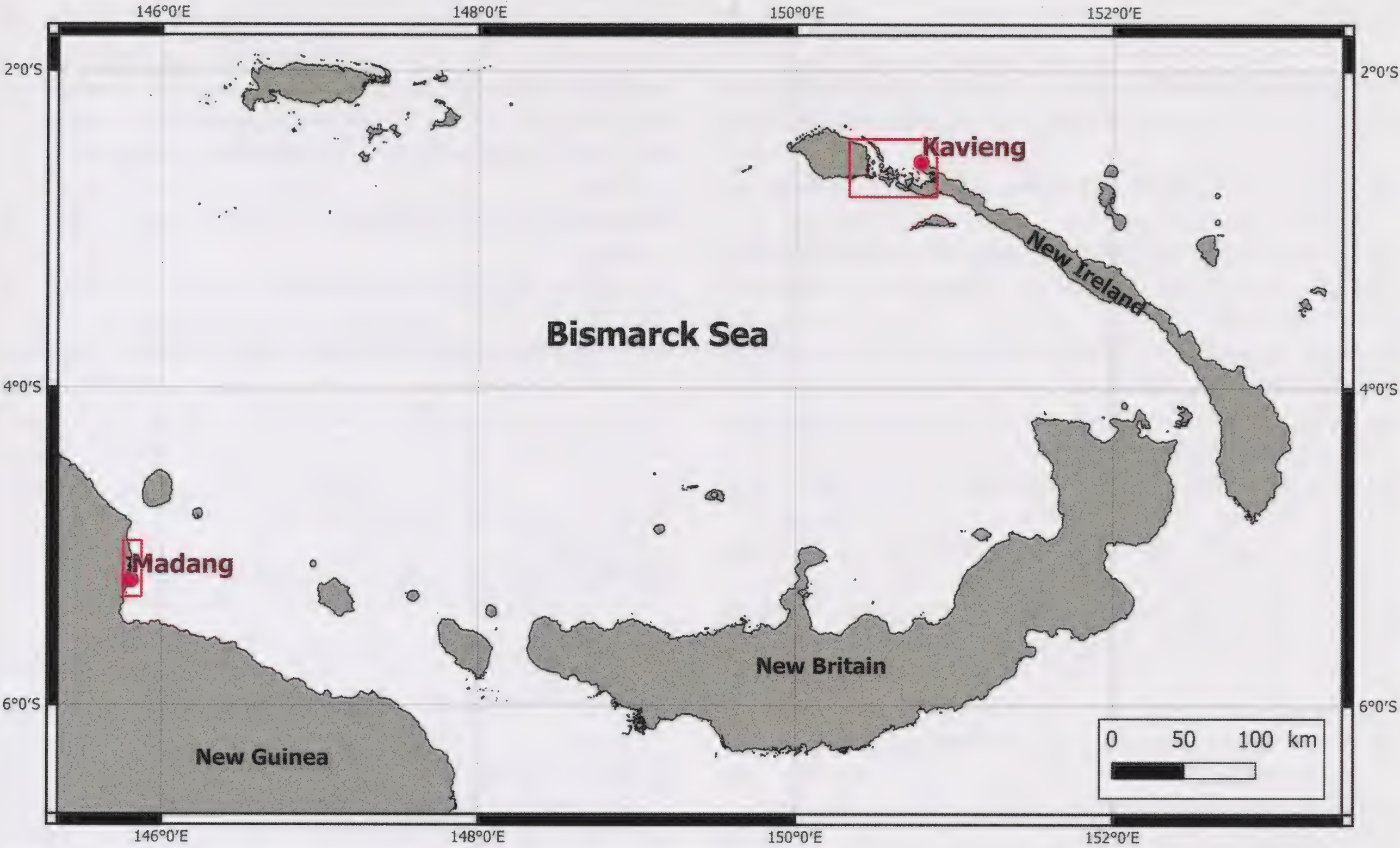
Appendix 2

Details on PAPUA-NIUGINI (2012) and KAVIENG (2014) Expeditions.

The 2012 Papua Niugini expedition (Principal Investigators Philippe Bouchet, Claude Payri and Sarah Samadi) was hosted between October and December 2012 at the Divine Word University (DWU) in Madang. It involved a total of 88 science participants from 18 countries, plus 51 trainees, media, logistics and visitors. It conducted 301 general dives (stations with prefix PR and PCT), 51 shore/freshwater sites (stations with prefix PM), 86 dredging series (stations with prefix PD), 49 suction

samples (PS) and 53 brushing baskets (PB), 14 sets of tangle nets (PP), and 42 grabs (PG). The Kavieng Lagoon Biodiversity Survey (Principal Investigators Philippe Bouchet, Claude Payri and Jeff Kinch) was hosted in June 2014 at Nago Island Mariculture and Research Facility, using the services of Kavieng Scuba Ventures and PNG Explorer for sampling from small boats. It involved a total of 35 participants from 12 countries. A total of 404 stations were surveyed, consisting of 179 general dives (stations with prefix KR and KZ), 44 suction samples (KS), 42 brushing baskets (KB), 37 shore sites (KM), and 87 dredging series (KD). The expeditions operated under permits delivered by the Papua New Guinea Department of Environment and Conservation (DEC).

Maps of research area.



List of the stations of PAPUA-NIUGINI (2012) and KAVIENG (2014) Expeditions containing specimens belonging to the family Caecidae. Locality, coordinates, depth, substrate and collecting methods are reported.

PAPUA-NIUGINI Expedition (2012)

- Stn PB01 - Kranket I., 05°11.3'S, 145°49.4'E, depth 6-10 m, lagoon entrance, brushing basket.
- Stn PB04 - Tab I., 05°10.1'S, 145°50.5'E, depth 30 m, East side, brushing basket.
- Stn PB05 - Kranket I., 05°11.7'S, 145°49.4'E, depth 20 m, inside the bay, brushing basket.
- Stn PB06 - Tab I., 05°09.9'S, 145°50.4'E, depth 20 m, brushing basket.

- Stn PB10 - BilBil I., 05°17.9'S, 145°46.7'E, depth 10 m, inner reef, brushing basket.
- Stn PB11 - Kranket I., 05°12.5'S, 145°49.1'E, depth 13 m, Cape Jantzen, brushing basket.
- Stn PB13 - BilBil I., 05°17.8'S, 145°46.9'E, depth 13 m, outer reef, brushing basket.
- Stn PB14 - Madang, 05°13.8'S, 145°48'E, depth 15 m, University road, brushing basket.
- Stn PB16 - N Sek I., 05°04.7'S, 145°48.8'E, depth 5 m, dans passe, rive sud, brushing basket.
- Stn PB17 - Sek I., 05°04.9'S, 145°49.3'E, depth 26 m, outer slope, brushing basket.
- Stn PB18 - Sek I., 05°06.3'S, 145°49.1'E, depth 26 m, outer slope, brushing basket.
- Stn PB19 - Megas Islet, 05°05.1'S, 145°48.6'E, depth 10 m, brushing basket.

Stn PB20 - Rempi Area, 05°02.1'S, 145°48.2'E, depth 32 m, outer slope, brushing basket.

Stn PB22 - Hargun I., 05°01.4'S, 145°48'E, depth 22 m, outer slope, brushing basket.

Stn PB24 - N Tadvai I., 04°59.1'S, 145°47.6'E, brushing basket.

Stn PB27 - Cape Barschtch, 05°03.9'S, 145°48.8'E, depth 12 m, brushing basket.

Stn PB28 - E Kranket I., 05°11.9'S, 145°49.6'E, depth 10 m, brushing basket.

Stn PB29 - Bilbil I., 05°18'S, 145°46.1'E, depth 17 m, brushing basket.

Stn PB30 - Tab I., 05°09.8'S, 145°50.3'E, depth 39 m, Reef close, brushing basket.

Stn PB31 - N Tab I., 05°09.4'S, 145°50'E, depth 31 m, Rasch Passage, brushing basket.

Stn PB32 - Wonad I., 05°08'S, 145°49.5'E, depth 31 m, outer slope, brushing basket.

Stn PB34 - N Wonad I., 05°07.1'S, 145°49.4'E, depth 15 m, N Mililat Passage, brushing basket.

Stn PB35 - S Sek I., 05°07'S, 145°49.4'E, depth 12 m, outer slope, brushing basket.

Stn PB36 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 17 m, outer slope, brushing basket.

Stn PB37 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 10 m, outer slope, brushing basket.

Stn PB38 - Yabob I., 05°15.3'S, 145°47.3'E, depth 13 m, outside, brushing basket.

Stn PB39 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 18-27 m, outer slope, brushing basket.

Stn PB40 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 9-11 m, outer slope, brushing basket.

Stn PB41 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 9-11 m, outer slope, brushing basket.

Stn PB45 - Sinub I., 05°07.9'S, 145°48.9'E, depth 8 m, brushing basket.

Stn PB46 - W Yabob I., 05°15.4'S, 145°47'E, depth 6 m, brushing basket.

Stn PB47 - N Kranket I., 05°11.3'S, 145°49.6'E, depth 5 m, brushing basket.

Stn PB48 - N Riwo, 05°08.7'S, 145°48.2'E, depth 2 m, mangrove and seagrass, brushing basket.

Stn PB49 - S Sek I., 05°06.4'S, 145°49.4'E, depth 6 m, brushing basket.

Stn PB50 - N Sek I., 05°04.7'S, 145°48.9'E, depth 3 m, inner slope, brushing basket.

Stn PB51 - N Bilbil I., 05°17.7'S, 145°46.9'E, depth 5 m, outside, brushing basket.

Stn PB52 - W Basimut I., 05°08.5'S, 145°48.2'E, brushing basket.

Stn PB53 - N Riwo, 05°08.1'S, 145°48.2'E, depth 3 m, Duad-natun I., brushing basket.

Stn PD02 - Madang, 05°12.5'S, 145°47.8'E, depth 3-8 m, E airport, dredge.

Stn PD03 - Madang, 05°13.2'S, 145°47.7'E, depth 2-3 m, in front of Maritime College, dredge.

Stn PD04 - Madang, 05°12.6'S, 145°47.8'E, depth 5-18 m, E airport, dredge.

Stn PD06 - Madang, 05°12.7'S, 145°47.9'E, depth 10-20 m, S airport, dredge.

Stn PD07 - Kranket I., 05°12'S, 145°48.8'E, depth 5-15 m, dredge.

Stn PD10 - W Kranket I., 05°11.7'S, 145°48.8'E, depth 16-28 m, dredge.

Stn PD14 - Madang Harbour, 05°12.3'S, 145°47.9'E, depth 10-15 m, E Nui I., dredge.

Stn PD17 - N Biliau I., 05°11.8'S, 145°48'E, depth 16 m, dredge.

Stn PD18 - Alexishafen, 05°05.3'S, 145°48.4'E, depth 5-10 m, W Megas Islet, dredge.

Stn PD19 - Alexishafen, 05°05.4'S, 145°48.5'E, depth 3-10 m, S Megas Islet, dredge.

Stn PD20 - Alexishafen, 05°05.3'S, 145°48'E, depth 10 m, dredge.

Stn PD23 - S Sek I., 05°06'S, 145°49.2'E, depth 3-7 m, dredge.

Stn PD25 - Sek I., 05°05'S, 145°49.1'E, depth 3-5 m, dredge.

Stn PD27 - W Sek I., 05°05'S, 145°48.7'E, depth 30-35 m, dredge.

Stn PD30 - Budup, 05°04.7'S, 145°48.3'E, depth 1-8 m, dredge.

Stn PD31 - Alexishafen, 05°05.3'S, 145°48.1'E, depth 1-6 m, dredge.

Stn PD35 - Rempi Area, 05°01.3'S, 145°47.9'E, depth 10-12 m, S Barag I., dredge.

Stn PD43 - Garup, 04°57.5'S, 145°47.2'E, depth 30 m, dredge.

Stn PD48 - Wonad I., 05°08.2'S, 145°49.4'E, depth 10-20 m, dredge.

Stn PD56 - Nagada Harbour, 05°09.7'S, 145°48.3'E, depth 2-5 m, dredge.

Stn PD63 - N Banap Damon Point, 05°09.9'S, 145°48.3'E, depth 0-15 m, dredge.

Stn PD66 - S Yabob I., 05°15.5'S, 145°47.3'E, depth 2-6 m, dredge.

Stn PD69 - S Yabob I., 05°15.5'S, 145°46.9'E, depth 2-6 m, dredge.

Stn PD72 - between Yabob & Bil Bil I., 05°16.2'S, 145°46.5'E, depth 20-25 m, dredge.

Stn PD86 - Bostrem Bay, 05°04.5'S, 145°46.6'E, depth 8 m, N Midibur, dredge.

Stn PM27 - Rempi Area, 04°59.3'S, 145°47.6'E, N Tadvai I., night tide, mangrove, sand with abundant soft corals, intertidal.

Stn PS03 - Kranket I., 05°11.5'S, 145°49.1'E, depth 13-16 m, West side, vacuum cleaning.

Stn PS05 - Kranket I., 05°11.5'S, 145°49.5'E, depth 8-9 m, inside, vacuum cleaning.

Stn PS06 - N Tab I., 05°10.0'S, 145°50.4'E, depth 15 m, vacuum cleaning.

Stn PS08 - N Siar I., 05°11.0'S, 145°48.4'E, depth 8 m, vacuum cleaning.

Stn PS09 - S Kranket I., 05°12.3'S, 145°48.8'E, depth 8-10 m, vacuum cleaning.

Stn PS12 - S Megas Islet, 05°05.3'S, 145°48.6'E, depth 6 m, vacuum cleaning.

Stn PS14 - Alexishafen, 05°05.3'S, 145°48.0'E, depth 8-13 m, vacuum cleaning.

Stn PS17 - N Kabanam Point, 05°06.0'S, 145°48.2'E, depth 2 m, vacuum cleaning.

Stn PS21 - Lauhamug I., 04°59.4'S, 145°47.6'E, depth 4 m, vacuum cleaning.

Stn PS22 - N Tadvai I., 04°59.1'S, 145°47.6'E, depth 11 m, vacuum cleaning.

Stn PS30 - E Wonad I., 05°08.2'S, 145°49.4'E, depth 10-37 m, vacuum cleaning.

Stn PS31 - E Wonad I., 05°08.2'S, 145°49.4'E, depth 10-37 m, vacuum cleaning.

Stn PS32 - W Wonad I., 05°08.1'S, 145°49.3'E, depth 19 m, vacuum cleaning.

Stn PS36 - Rasch passage, 05°09.1'S, 145°49.8'E, depth 34 m, vacuum cleaning.

Stn PS38 - N Wonad I., 05°07.1'S, 145°49.4'E, depth 15 m, N Mililat Passage, vacuum cleaning.

Stn PS39 - NW Riwo I., 05°08.5'S, 145°48.3'E, depth 17 m, vacuum cleaning.

Stn PS40 - S Sek I., 05°07.0'S, 145°49.4'E, depth 17 m, outer slope, vacuum cleaning.

- Stn PS41 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 10 m, outer slope, vacuum cleaning.
- Stn PS42 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 18-27 m, outer slope, vacuum cleaning.
- Stn PS43 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 14 m, outer slope, vacuum cleaning.
- Stn PS44 - S Urembo I., 05°15.9'S, 145°47.1'E, depth 11 m, outer slope, vacuum cleaning.
- Stn PS45 - W Yabob I., 05°15.4'S, 145°47.0'E, depth 6 m, vacuum cleaning.
- Stn PS46 - N Riwo, 05°08.7'S, 145°48.2'E, depth 2 m, mangrove and seagrass, vacuum cleaning.
- Stn PS47 - N Sek I., 05°04.7'S, 145°48.9'E, depth 8 m, inner slope, vacuum cleaning.

KAVIENG Expedition (2014)

- Stn KB02 - Kavieng Lagoon, 02°35.2'S, 150°46.2'E, depth 6 m, W entrance to Nissel Passage, coral slabs and rubble, brushing basket.
- Stn KB06 - Kavieng Lagoon, 02°41.2'S, 150°41.2'E, depth 8 m, NW point of Manne I., silty slope with coral debris, brushing basket.
- Stn KB08 - New Ireland, 02°33.2'S, 150°48.2'E, depth 13 m, E of N Cape, bottom of reef slope, brushing basket.
- Stn KB12 - Kavieng Lagoon, 02°41.2'S, 150°41.2'E, depth 4 m, NW corner of Manne I., dead coral slope, brushing basket.
- Stn KB14 - Kavieng Lagoon, 02°34'S, 150°47.1'E, depth 10 m, NE corner of Nusa I., outer slope with much coral rubble, brushing basket.
- Stn KB16 - Kavieng Lagoon, 02°34.6'S, 150°46.3'E, depth 13-14 m, betw. Big Nusa and Little Nusa, oceanfront reef, brushing basket.
- Stn KB18 - Kavieng Lagoon, 02°40.8'S, 150°42.7'E, depth 4-7 m, N coast of Manne I., coral slope with mud, brushing basket.
- Stn KB20 - Kavieng Lagoon, 02°45.2'S, 150°41.7'E, depth 8 m, S coast of Baudison I., wall with large ledges, brushing basket.
- Stn KB22 - Kavieng Lagoon, 02°45.2'S, 150°43.1'E, depth 8-24 m, Middle of Albatross Channel, rubble slope, brushing basket.
- Stn KB26 - Kavieng Lagoon, 02°44.6'S, 150°43'E, depth 9-15 m, entrance of Albatross Passage, silty sand, dead coral rubble, brushing basket.
- Stn KB28 - Kavieng Lagoon, 02°43.7'S, 150°38.4'E, depth 15-26 m, S side of Baudison I., coral slope, brushing basket.
- Stn KB30 - Kavieng Lagoon, 02°44.4'S, 150°39.1'E, depth 8-15 m, S side of Baudison I., rubble slope, brushing basket.
- Stn KB34 - Kavieng Lagoon, 02°43.7'S, 150°37.1'E, depth 43 m, Isolated bommie at entrance to Steffen Channel, drop off, brushing basket.
- Stn KB36 - Kavieng Lagoon, 02°38.8'S, 150°38.4'E, depth 3-8 m, N side of Wadei I., sand and rubble slope, brushing basket.
- Stn KB38 - Kavieng Lagoon, 02°36.2'S, 150°31.6'E, depth 6-8 m, S side of Patio I., coral rubble slope, brushing basket.
- Stn KB40 - Kavieng Lagoon, 02°36.6'S, 150°32.9'E, depth 2-7 m, Byron Channel, SE Patio I., rubble slope, brushing basket.
- Stn KB42 - Kavieng Lagoon, 02°38.3'S, 150°27.2'E, depth 6-12 m, SE tip of New Hanover near Alton I., rubble slope, brushing basket.
- Stn KB44 - Kavieng Lagoon, 02°40'S, 150°27.7'E, depth 12-16 m, N of Tungelo I., coral slope, few small overhangs, brushing basket.
- Stn KB46 - Kavieng Lagoon, 02°34.6'S, 150°33'E, depth 8 m, Senta Pass, Nusakelo I., sand, sparse rubble, brushing basket.
- Stn KB50 - Kavieng Lagoon, 02°32.5'S, 150°35.4'E, depth 24 m, Martha's Shoal, brushing basket.
- Stn KB54 - Kavieng Lagoon, 02°31.9'S, 150°27.5'E, depth 11 m, E side of Anelaua I., sand and ledge with coral, brushing basket.
- Stn KB56 - Kavieng Lagoon, 02°29.1'S, 150°28.8'E, depth 3-5 m, W side of Kawauiliaka I., silty reef, brushing basket.
- Stn KB58 - Kavieng Lagoon, 02°34.1'S, 150°37.5'E, depth 12 m, N point of Nusalomon I., coral mound, sand and rubble, brushing basket.
- Stn KB60 - Kavieng Lagoon, 02°32.5'S, 150°35.3'E, depth 20 m, Martha's Shoal, sand and coarse rubble in gutter, brushing basket.
- Stn KB62 - Kavieng Lagoon, 02°36.4'S, 150°42.4'E, depth 19 m, NW side of Ral I., small, 2-3 m, wall, with blockS on sand at base, brushing basket.
- Stn KB70 - Kavieng Lagoon, 02°46.1'S, 150°45.2'E, depth 37 m, E of Albatross Passage, small ledge on wall, brushing basket.
- Stn KB72 - Kavieng Lagoon, 02°35.2'S, 150°43.1'E, depth 13 m, Mouth of Albatross Passage, E side, rubble slope, brushing basket.
- Stn KD04 - Kavieng Lagoon, 02°36.1'S, 150°45.7'E, depth 16-22 m, W of Nago I., sand with rocky rubble, dredge.
- Stn KD06 - Kavieng Lagoon, 02°42'S, 150°52.5'E, depth 1 m, entrance to Tome River, mud with rotting leaves, dredge.
- Stn KD07 - Kavieng Lagoon, 02°42'S, 150°52.1'E, depth 1-2 m, entrance to Tome River, mud with rotting leaves, dredge.
- Stn KD28 - New Ireland, 02°43.4'S, 150°42.4'E, depth 1 m, betw. S tip of Manne I. and mainland New Ireland, algae and mud near mangrove, dredge.
- Stn KD36 - Kavieng Lagoon, 02°35.1'S, 150°29'E, depth 8 m, S of Anelaua I., sand and rubble, dredge.
- Stn KD37 - Kavieng Lagoon, 02°39.4'S, 150°26.9'E, depth 15-20 m, Chamisso Channel, dredge.
- Stn KD38 - Kavieng Lagoon, 02°39.1'S, 150°27'E, depth 18-20 m, Mascot Channel, dredge.
- Stn KD40 - Kavieng Lagoon, 02°34.1'S, 150°35.3'E, depth 40-60 m, SW of Marthas Shoal, dredge.
- Stn KD51 - Kavieng Lagoon, 02°40.9'S, 150°52.1'E, depth 1-2 m, entrance to Pukpuk River, mud, dredge.
- Stn KD56 - Kavieng Lagoon, 02°41.2'S, 150°50.5'E, depth 6-8 m, Balgai Bay, dark silt, dredge.
- Stn KD60 - Kavieng Lagoon, 02°35.2'S, 150°46.8'E, depth 1-3 m, E corner of Nusa I., sand and seagrass, dredge.
- Stn KD61 - Kavieng Lagoon, 02°34.4'S, 150°34.3'E, depth 4-5 m, Around Pochol I., sand, seagrass, dredge.
- Stn KD62 - Kavieng Lagoon, 02°34'S, 150°33.7'E, depth 6-7 m, Around Pochol I., sand, broken shells, dredge.
- Stn KD65 - Kavieng Lagoon, 02°40.4'S, 150°34.2'E, depth 1-3 m, N of Selapiu I., muddy sand, dredge.
- Stn KD67 - Kavieng Lagoon, 02°38.4'S, 150°48.6'E, depth 1-3 m, E of Cape Sueusat, mud, seagrass, dredge.
- Stn KD85 - New Ireland, 02°44.2'S, 150°42.3'E, depth 2-5 m, betw. Manne I. and New Ireland mainland, rubbly coral and sand, dredge.
- Stn KD86 - New Ireland, 02°42.6'S, 150°43.4'E, depth 5-8 m, betw. Manne I. and New Ireland mainland, silty to rubbly sand, with small rocks and sponges, dredge.
- Stn KD90 - Kavieng Lagoon, 02°40.9'S, 150°39.8'E, depth 12-15 m, Silver Sound, coral rubble, dredge.
- Stn KL03 - Kavieng Lagoon, 02°38.3'S, 150°38.4'E, depth 0-2 m, SE corner of Nusaum I., sand, rubble with algae.
- Stn KM24 - New Ireland, Lemus I., 02°38'S, 150°37.5'E, depth 0-1 m, mixed platform with seagrass, intertidal collection.

- Stn KM28 - New Ireland, Limonak I., 02°41.3'S, 150°45.7'E, depth 0-1 m, sand with seagrass and coral debris, intertidal collection.
- Stn KPD05 - Lissenung Island, 02°40'S, 150°44.1'E, depth 0-1 m, beach, hand dredge.
- Stn KPR06 - Lissenung Island, 02°40'S, 150°44.1'E, depth 2-7 m, sandy area in front of small reef, scuba.
- Stn KPR07 - Manne Island, 02°45.4'S, 150°41.3'E, depth 22-27 m, sediment in ledges, reef wall, scuba.
- Stn KPS02 - Albatross Passage, 02°45'S, 150°43'E, depth 14-32 m, sediment in ledges, reef wall, hand-brushed sediment.
- Stn KPS09 - Baudisson Island, 02°41.6'S, 150°37.2'E, depth 18-27 m, sediment in ledges, reef wall, hand-brushed sediment.
- Stn KPS10 - Baudisson Island, 02°41.6'S, 150°37.2'E, depth 12-14 m, sediment between coral patches, hand-brushed sediment.
- Stn KPS11 - Lemus Island, 02°38.3'S, 150°37.4'E, depth 8-19 m, sediment in ledges, reef slope, hand-brushed sediment.
- Stn KPS12 - Nusa Island, 02°34.1'S, 150°46.5'E, depth 14-21 m, rubble between rocks with algae, hand-brushed sediment.
- Stn KPS13 - Nusa Island, 02°34.1'S, 150°46.5'E, depth 15 m, mud ca. 2 m inside cave, hand-brushed sediment.
- Stn KPS17 - SW New Ireland, 02°45.9'S, 150°44.7'E, depth 17-23 m, sediment in ledges, reef slope, hand-brushed sediment.
- Stn KR186 - New Ireland, 02°46'S, 150°44.8'E, depth 3-57 m, New Ireland mainland E of Albatross Passage, wall and rubble slope, scuba.
- Stn KR57 - Kavieng Lagoon, 02°45.7'S, 150°44.5'E, depth 2-41 m, E of Albatross Passage, wall with caves and ledges, scuba.
- Stn KS09 - Kavieng Lagoon, 02°36.1'S, 150°45.9'E, depth 15-16 m, W of Nago I., edge of coral drop off slope, vacuum cleaning.
- Stn KS19 - Kavieng Lagoon, 02°34'S, 150°47.1'E, depth 10 m, NE corner of Nusa I., outer slope with much coral rubble, vacuum cleaning.
- Stn KS21 - Kavieng Lagoon, 02°34.6'S, 150°46.3'E, depth 4 m, betw. Big Nusa and Little Nusa, oceanfront reef, vacuum cleaning.
- Stn KS23 - Kavieng Lagoon, 02°40.8'S, 150°42.7'E, depth 4-7 m, N coast of Manne I., coral slope with mud, vacuum cleaning.
- Stn KS25 - Kavieng Lagoon, 02°45.3'S, 150°43.4'E, depth 13 m, Albatross Passage, undercut ledge, vacuum cleaning.
- Stn KS27 - Kavieng Lagoon, 02°42.7'S, 150°41.7'E, depth 12 m, betw. Manne and Baudison I., fine mud, vacuum cleaning.
- Stn KS31 - Kavieng Lagoon, 02°39.5'S, 150°37.7'E, depth 15 m, Steffen Strait, W side of Wadei I., bottom of coral slope, vacuum cleaning.
- Stn KS35 - Kavieng Lagoon, 02°38.8'S, 150°40.7'E, depth 4-5 m, NW Reef off Kabotteron I., vacuum cleaning.
- Stn KS39 - Kavieng Lagoon, 02°37.2'S, 150°31.8'E, depth 20 m, NW point of Nubis I., large ledge flat bottom, vacuum cleaning.
- Stn KS45 - New Hanover, 02°40.5'S, 150°20.3'E, depth 8-12 m, S coast, outside Metanus Harbour, silty coral slope, vacuum cleaning.
- Stn KS53 - Kavieng Lagoon, 02°31.9'S, 150°27.5'E, depth 8 m, E side of Anelaua I., sand and ledge with coral, vacuum cleaning.
- Stn KS55 - Kavieng Lagoon, 02°29.1'S, 150°28.8'E, depth 4-6 m, W side of Kawauiliaka I., silty reef, vacuum cleaning.
- Stn KS57 - Kavieng Lagoon, 02°38.9'S, 150°40.1'E, depth 7-9 m, N point of Kabotteron I., coral mound with slabs surrounded by a maerl bed, vacuum cleaning.
- Stn KS59 - Kavieng Lagoon, 02°39.5'S, 150°39.7'E, depth 3 m, SW point of Ungon I., seagrass, vacuum cleaning.
- Stn KS61 - Kavieng Lagoon, 02°35.2'S, 150°43.1'E, depth 9-13 m, Mouth of Albatross Passage, E side, rubble slope, vacuum cleaning.
- Stn KZ16 - Kavieng Lagoon, 02°34.7'S, 150°47.5'E, depth 1-2 m, Kavieng, in front of market, silty rocks with algae, scuba.
- Stn KZ23 - Kavieng Lagoon, 02°36.7'S, 150°45.3'E, depth 7-8 m, betw. Nusa I. and Edmago I., soft coral, coral rubble, living coral, scuba.
- Stn KZ25 - Kavieng Lagoon, 02°38.8'S, 150°38.4'E, depth 8-10 m, N side of Wadei I., scuba.

TABLES

Tables should be composed as text files, exactly at printing size (see under Illustrations), using a *sans-serif* font not smaller than 8-9 pts. Avoid thick borders and heavy grids. They are referred to in the text as Tab. (e.g. **Tab. 2**, **Tabs 3–6**, not Tabs.). Abbreviations are explained in the captions or under Material and methods. Tables are kept as separate files, not embedded in the text.

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Subfamily Cardiinae Lamarck, 1809
Genus *Acanthocardia* Gray, 1853
(type species *Cardium aculeatum* Linné, 1758)

Cardium indicum Lamarck, 1819
(Fig. 1. A-D, Fig. 2. C)

Cardium hians Brocchi, 1814: p. 508, tav. 13, fig. 6 (non Spengler, 1799).
Cardium indicum Lamarck, 1819: p. 4.
Cardium (Cardium) indicum Lamarck – Fischer-Piette, 1977: p. 112, tav. 10, fig. 4 (tipo).

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SALAS C., 1996. Marine Bivalves from off the Southern Iberian Peninsula collected by the Balgim and Fauna 1 expeditions. *Haliotis*, **25**: 33-100.
GRILL B. & ZUSCHIN M., 2001. Modern shallow- to deep-water bivalve death assemblages in the Red Sea – ecology and biogeography. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **168**: 75-96.
BOSS K.J., 1982. Mollusca, in Parker S.P. (ed.), *Synopsis and Classification of Living Organisms*. Vol. 1. McGrow-Hill, New York: 945-1166.
CARTER J.G., CAMPBELL D.C. & CAMPBELL M.R. 2000. Cladistic perspectives on early bivalve evolution, in Harper E.M., Taylor J.D. & Crame J.A. (eds), The Evolutionary Biology of the Bivalvia. *Geological Society, London, Special Publications*, **177**: 47-95.
VOKES H.E., 1980. *Genera of the Bivalvia: a systematic and bibliographic catalogue (revised and update)*. Paleontological Research Institution, Ithaca, Edwards Brothers Inc., 307 pp.

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Le illustrazioni devono essere di alta qualità, in formato elettronico (.tiff), con una risoluzione non più bassa di 300 dpi per le fotografie e di 600 dpi per i disegni ed i grafici. Vanno preparate alle esatte dimensioni di stampa, in formato colonna singola (8,4 cm) o colonna doppia (17,2 cm). L'area di stampa massima è 17,2 × 26,5 cm. La dimensione delle illustrazioni va scelta con attenzione e buon senso, sulla base della complessità e quantità delle immagini contenute, al fine di ovviare a risultati scientificamente poco utili ed esteticamente poveri, oltre allo spreco di spazio di stampa. Tutte le illustrazioni sono numerate progressivamente, in un'unica serie, con numeri arabi, nello stesso ordine in cui sono citate nel testo. Nelle illustrazioni composite, le singole immagini vanno indicate con lettere maiuscole, di altezza pari a 3-5 mm, usando un carattere *sans-serif*, quale Helvetica od Arial. Indicazioni ed abbreviazioni sulle illustrazioni vanno in minuscolo. Le illustrazioni vanno citate nel testo come figure, usando le abbreviazioni **Fig.** e **Figg.** come nell'esempio: **Fig. 3**, **Fig. 6. A-F**, **Fig. 5. A**, **7. B**, **Figg. 3, 5**. Le illustrazioni in altri lavori vanno citati come fig. o figg. Le immagini, montate su fondo nero o bianco, devono avere dimensioni adeguate ad un'agevole lettura, non più piccole di 4-5 cm, né eccessivamente grandi. Devono essere appropriatamente disposte nello spazio disponibile, in modo da evitare ampie aree vuote. Lineette di scala, nere o bianche, possono essere applicate sulle illustrazioni. Le mappe vanno preparate come figure al tratto, semplici e prive di elementi grafici non utili ai fini del lavoro (es.: confini di stato), con le località citate nel testo ben evidenti. Le illustrazioni vanno tenute separate dal testo. La pubblicazione di illustrazioni a colori deve essere preliminarmente accordata con il Direttore Scientifico. Gli originali delle illustrazioni vanno spediti solo dopo l'accettazione definitiva del manoscritto.

TABELLE

Le tabelle vanno composte come files di testo, esattamente alla dimensione di stampa (si veda Illustrazioni), con un carattere *sans-serif* non più piccolo di 8-9 punti. Vanno evitati bordi spessi e griglie eccessivamente pesanti. Le tabelle sono citate nel testo come Tab. (es.: **Tab. 2**, **Tabb. 3–6**). Le abbreviazioni vanno spiegate in didascalia o nei Materiale e metodi. Le tabelle non vanno inserite nel testo, ma salvati come files separati.

DIDASCALIE

Le didascalie vengono riportate in una parte distinta del manoscritto, raggruppate ed in sequenza. Devono comprendere: nome ed autore della specie illustrata, origine del materiale, dimensioni reali (non l'ingrandimento!) e la collocazione (con numero di catalogo, se disponibile). Per i manoscritti in una lingua diversa dall'Inglese, è necessario aggiungere la traduzione in Inglese delle didascalie.

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